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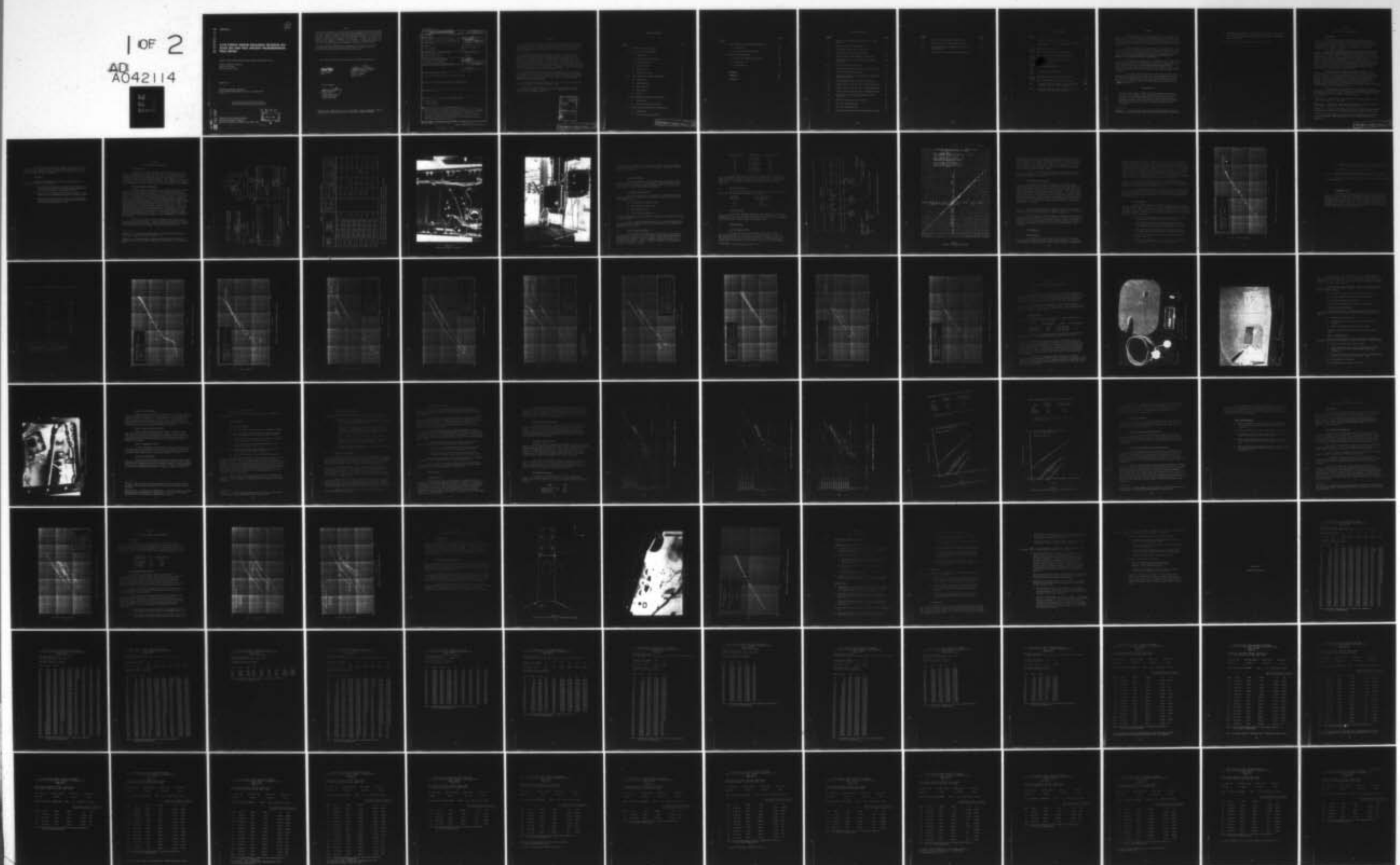

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A-37B FATIGUE SENSOR EVALUATION PROGRAM FULL SCALE TEST AND FIELD AIRCRAFT INSTRUMENTATION FINAL REPORT

DEPUTY FOR SYSTEMS SPECIALIZED AIRCRAFT PROGRAM OFFICE

CESSNA AIRCRAFT COMPANY
WALLACE DIVISION
WICHITA, KANSAS 67201

MARCH 1977

TECHNICAL REPORT ASD-TR-77-4
FINAL REPORT FOR PERIOD JULY 1971 - JANUARY 1976

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AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
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Micro Measurements FM Fatigue Sensors were installed on A-37 aircraft at three CONUS bases to determine the longevity and suitability of this device for field installation. A similar installation on an A-37B full scale fatigue test provided base line data for relative severity comparisons of accumulated fatigue. The sensor is shown to be practical for field installation and this report recommends field installations designed for more advanced data analysis methods.

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FOREWORD

This Full Scale Test and Field Aircraft Instrumentation Fatigue Sensor Evaluation Program was conducted by the Cessna Aircraft Company of Wichita, Kansas under Air Force contract no. F33657-71-C-0163. The contract was initiated under project A-37B (335A) "A-37B Final Fatigue Program" and Task no. P00026.

The program from initiation through the issuance of Cessna Report 318E-7419-039, "Fatigue Sensor Evaluation Program - Interim Full-Scale Fatigue Test and Field Aircraft Instrumentation Report," was supervised and directed by Robert W. Walker, Group Leader. This report which is an extension of the previous work to include final field data measurements, was prepared by John Y. Kaufman, Design Engineer. This project was initiated by Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, and was administered under the co-ordination of Richard C. Culpepper (ASD/SD27MS) Aircraft Structural Integrity Program Manager, A-37B.

The interim report covered the results obtained from fatigue sensor installations on a full scale fatigue test and various field installations and compares these results with predictions based on a known load spectrum. The additional field data contained in this report confirms the trends established in the earlier report.

This report covers work conducted from July, 1971 until January, 1976. It was submitted by the author in November, 1976.

Publication of this report does not constitute Air Force Approval of the reports' findings or conclusions. It is published only for the exchange and stimulation of ideas.

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SUMMARY

Commercially available fatigue sensors have been evaluated for application to aircraft structural fleet monitoring by the on going A-37 ASIP programs. The final full-scale wing and carry-thru fatigue test and sixteen operational A-37 field aircraft have been instrumented with Micro-Measurement FM fatigue sensors and response evaluated in terms of structural fatigue severity.

These installations were made prior to the availability of the currently used data analysis methods (see Reference 1), and were designed only for longevity and adequate response. The results, therefore, consist only of relative severity indications. None the less, the basic program objective of evaluating reliability, longivity, and feasibility of application in operational aircraft has been met.

Fatigue sensor response from the fatigue test was compared to field aircraft response for development of severity of usage trends. These trends were compared to measured strain history/fatigue damage data from the mechanical strain gage. Comparisons indicate fatigue sensor response trends are compatible and consistent with measured strain history/fatigue damage trends for both the full scale test and operational field aircraft.

The fatigue sensor application to aircraft structural fleet monitoring shows promise (this promise is further amplified in Reference 1). Fatigue sensor structural usage trends have been compatible with other available fleet monitoring data, and field aircraft instrumentation and long term data collection have been accomplished with minimum aircraft downtime/user impact.

RECOMMENDATIONS

1. Install fatigue sensors suitable for the data analysis methods of Reference 1 on a sample of USAF Continental United States' aircraft, preferably aircraft with operative Life History Recorder and/or Mechanical Strain Recorder installations. Apply the data analysis methods and compare results with Life History Recorder and Mechanical Strain Recorder results for field verification and application refinement.

Reference 1. - "A-37B Fatigue Sensor Data Analysis Methodology Program", Aeronautical Systems Division Technical Report ASD-TR-75-42, October 1975.

2. Instrument each new production aircraft with fatigue sensors selected for long term monitoring. This data could be used to aid in the disposition of future structural integrity problems or formulating inspection policy.

3. Refine techniques of application and data analysis.

SECTION I

INTRODUCTION AND DISCUSSION

A INTRODUCTION

This report presents the work effort and results of the Fatigue Sensor Evaluation program on the A-37 final full-scale fatigue test and operational field aircraft. Thirty-six months of data collection and analysis are covered by this report. This work was conducted per requirements of Reference 2 and under the authorization of Contract F33657-71-C-0163, P00037 and P00026.

This report is organized into six sections and two appendices. Section I contains the introduction and discussion and Section II describes full-scale fatigue test instrumentation and data analysis. Sections III and IV discuss field aircraft instrumentation using new FM fatigue sensors and Reference 3 original fatigue sensors on the lower wing spar. Section V contains landing gear instrumentation of field aircraft. Section VI describes the installation of sensors on the forward banjo fitting of LHR aircraft and Section VII provides a program summary of results and conclusions. Appendix A documents fatigue sensor data collected from both the fatigue test and field aircraft. Appendix B presents measured strain spectrums used to predict fatigue sensor response.

Fatigue sensors were installed and data collected at eight locations on the final full-scale wing and carry-thru fatigue test, at one wing location on sixteen operational A-37B aircraft and on the landing gear of two aircraft to evaluate the feasibility of sensor application to aircraft structural fleet monitoring. In addition, the forward banjo fittings of six new production aircraft were instrumented late in the program. Micro-Measurement FM [a] fatigue sensors were used for all instrumentation based on results of the Initial Evaluation Program (Reference 3) and Laboratory Test Program (Reference 4).

Full-scale test data were used to form calibration response (response to a known loading) for comparison to operational aircraft response as a measure of severity of usage. Usage severity trends developed for the data collection period are presented by this report.

Reference 2. - "Fatigue Sensor Evaluation, Final Fatigue Program", Cessna Report 318E-6918-213K, 2 June, 1972.

Reference 3. - "Program for Evaluation of Annealed Foil Fatigue Sensors," Final Report, Cessna Report 318E-7219-029, 30 June 1972.

Reference 4. - "Fatigue Sensor Evaluation Program - Laboratory Test Report," Aeronautical Systems Division Technical Report ASD-TR-75-33, October 1975.

[a] FM Sensor - Trade name of a fatigue life gage assembly which contains a load and temperature compensating strain gage, and a mechanical strain amplifier.

Predictions of fatigue sensor response are made for both the full-scale test and field aircraft using measured load spectra. These predictions are compared to actual response for correlation of fatigue sensor data with the measured spectra.

B DISCUSSION

Fatigue sensor application to aircraft structural fleet monitoring continued to show promise:

a) Long term data collection is possible with minimum effort required; consistent data trends have been indicated for 1,000 hours operation on individual aircraft.

b) Field aircraft instrumentation and data collection caused minimum aircraft downtime and produced no burden on users.

c) Fatigue sensor usage severity trends are consistent and compatible with measured strain history data on both full-scale test and operational aircraft.

SECTION II

FULL-SCALE TEST CALIBRATION

A INTRODUCTION

Fatigue sensors were installed, as shown in Figure 1, at six critical structure areas of the A-37 Final Full-Scale Wing and Carry-Thru Fatigue Test conducted per Reference 5 test plan. Sensors were monitored periodically during the test and resulting data were compiled to form calibration curves for each critical location. The calibrated test response at a given structure location forms a baseline for a comparison of fatigue sensor response at the same structure location on operational field aircraft.

B FATIGUE SENSOR INSTALLATION

Fatigue Sensors were installed near suspected critical structure locations based on results of fatigue analysis, previous fatigue tests (Reference 3), and engineering judgement. Six structural areas and eight sensor locations were selected for instrumentation as listed by Table 1 and Figure 1. Two sensors were installed per critical location on the RH and LH sides of the structure. In addition, Micro-Measurement TG temperature sensors were installed adjacent to sensor location #4 on the RH and LH front spar to monitor structure temperature for each fatigue sensor reading. The data collection panel/Vishay indicator (Figure 3) were used to read temperature sensors. The Micro-Measurement FM fatigue sensor was used for all installations; previous evaluation programs (References 3 and 4) have indicated the suitability of the FM sensor for this application. Fatigue sensors were installed per manufacturer's instructions (Reference 6) and using techniques described in Reference 4. Micro-Measurement M-16 adhesive was used for all installations. Figure 2 shows a photograph of a typical installation.

Four sets of fatigue sensor installations were made during the fatigue test as noted by Table 1. These installations coincided with test start and major test inspections. Several sensor installations were replaced with adjusted multipliers to achieve desired calibration response.

Reference 5. - Cessna Report 318E-7016-165, "Final Full-Scale Wing and Carry-Thru Fatigue Test", dated 20 August 1973.

Reference 6. - Micro-Measurement Instruction Bulletin B-142, "FM Series Multiplier and M Bond M-16 Cement Application Instruction", dated 2 February 1972.

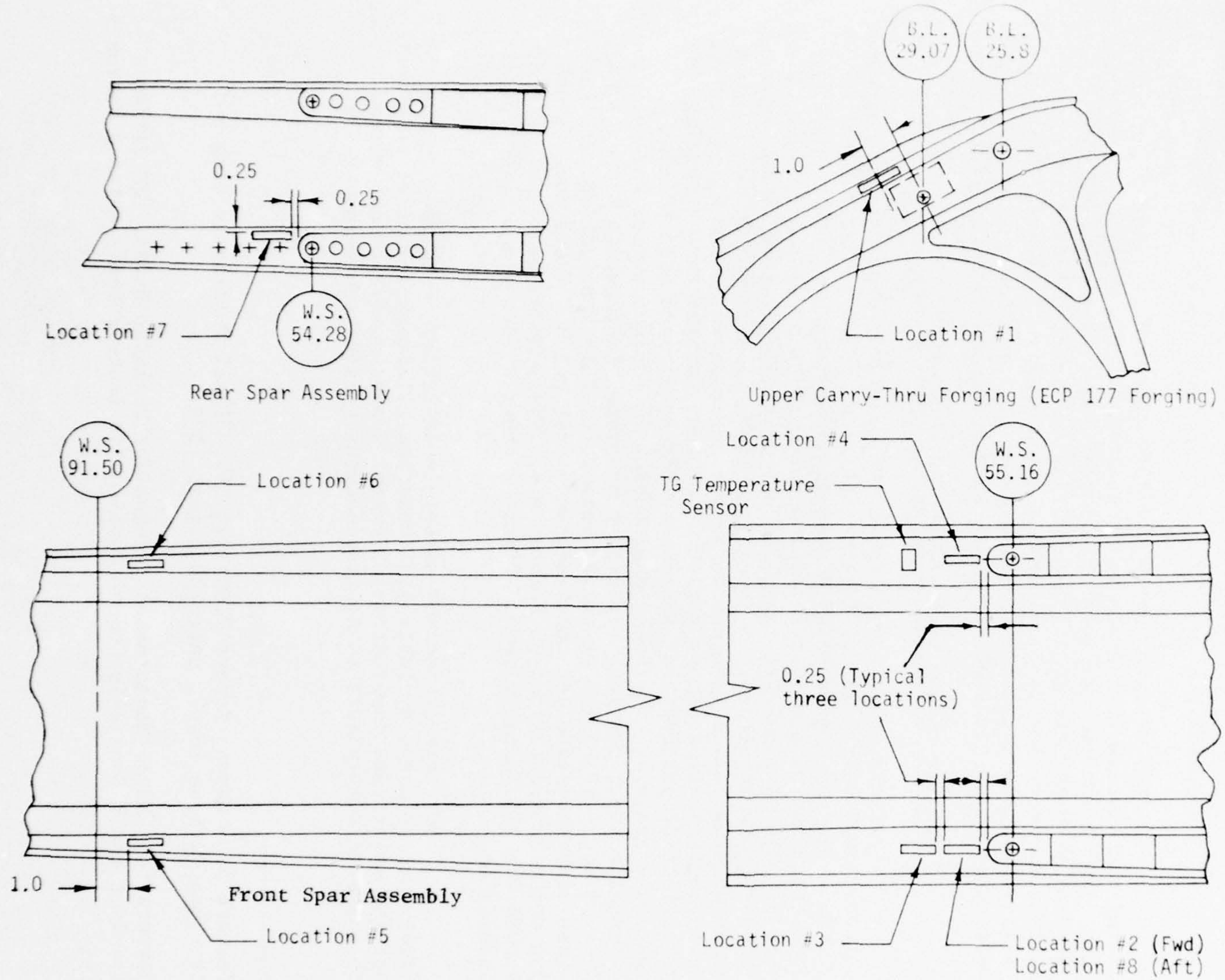


Figure 1 - Fatigue Test Installation Locations

TABLE 1 - FATIGUE TEST INSTALLATION SUMMARY

SENSOR LOCATION NO.	STRUCTURAL AREA DESCRIPTION (see Figure 2-2)	INSTL. NO.	#1	#2	#3	#4
		DATE	10-2-73	1-9-74	5-3-74	9-3-74
		TEST HOURS	0	6064	14148	23470
			MULTIPLIER SETTING PER INSTALLATION			
1R, 1L	Upper carry-thru forging, B.L. 30.00		5.0			
2R, 2L	Lower front spar cap, W.S. 56.80, Fwd side		2.6			
3R, 3L	Lower front spar cap, W.S. 58.18, Fwd side		4.0	2.6		
4R, 4L	Upper front spar cap, W.S. 56.80, Fwd side		3.5	2.6		
5R, 5L	Lower front spar cap, W.S. 89.94, Fwd side		3.5**	3.5	2.6***	
6R, 6L	Upper front spar cap, W.S. 89.94, Fwd side		3.5**	3.5	2.6	
7R, 7L	Lower rear spar cap, W.S. 55.56, Aft side			3.5		
8R, 8L*	Lower front spar cap, W.S. 56.80, Aft side					2.6

* This installation duplicates location used for field aircraft

** Poor multiplier installation, air bubbles in adhesive, data not plotted

*** Structural beef-up has been installed adjacent to these sensors

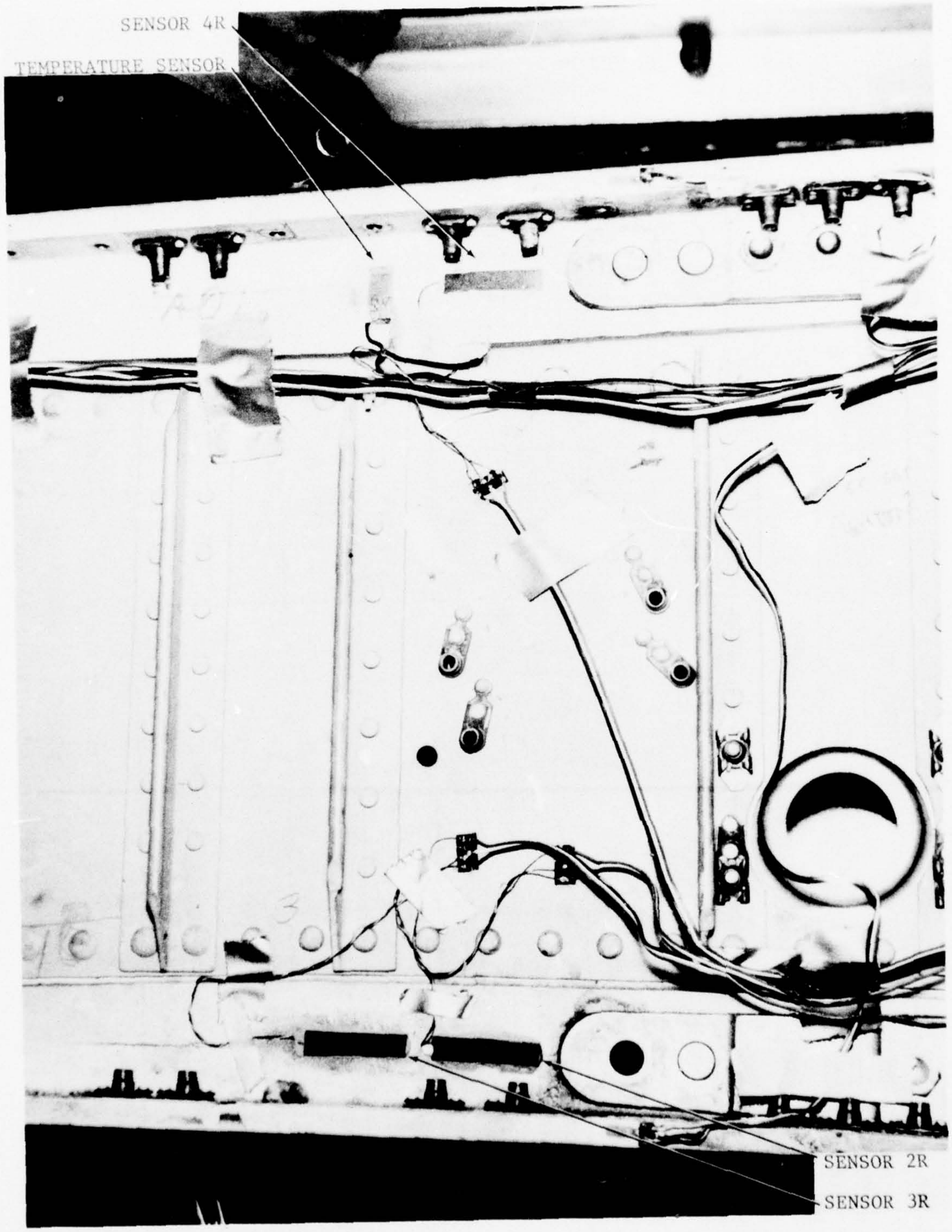


Figure 2
Inboard Front Spar Installation

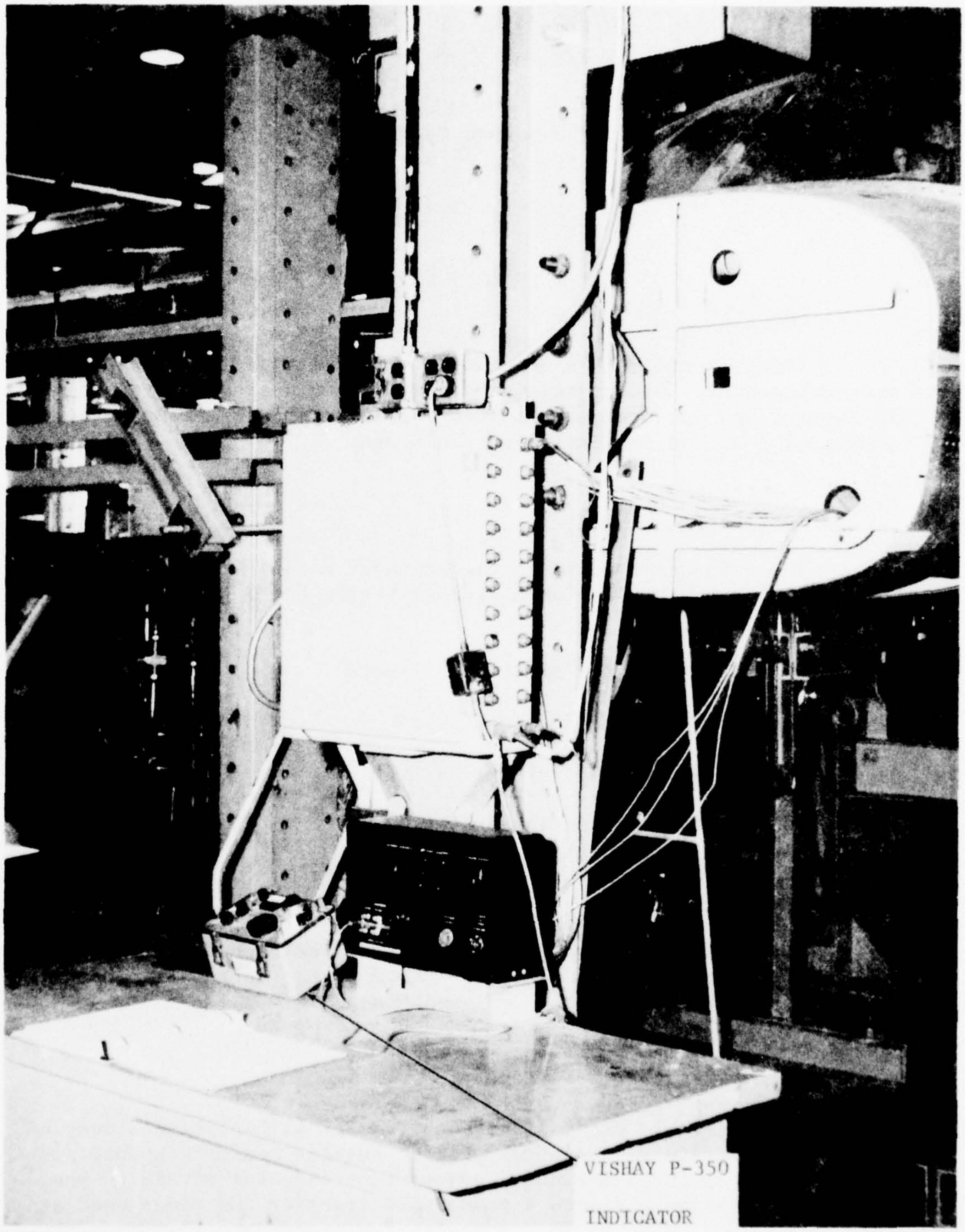


Figure 3
Full Scale Fatigue Test, General View

Location #7 was added during the second installation to provide coverage of the rear spar structure. Location #8 was added to duplicate the field aircraft installation.

C PREDICTED RESPONSE

Initial predictions to select multipliers (before test start) were made using a preliminary strain spectrum. Final predictions shown by this report used measured strain spectrums based on a range pair type cycle count of measured sequential strain peaks.

1 Test Spectrum Description

The full-scale test was cycled under a flight-by-flight spectrum loading which was applied on a repeating time block basis. One time block consisted of:

a) 500 individual simulated flights

b) 505.3 simulated flight hours

c) 31044 applied cycles

d) 5 test load configurations

Seventy blocks were applied for a total of 35371 test hours (8843 safe life), or 35,000 flights.

NOTE: A complete description of the test spectrum organization is presented by Reference 5 and the strain exceedance data is included in Appendix B of this report.

2 Strain Transfer Function

The available strain load spectrum for each critical location was based on net strain at a control point. Fatigue sensor response predictions used a transfer function to adjust control point strain to the fatigue sensor location. Figure 4 summarizes transfer functions used at the lower front spar, W.S. 55.16. Transfer functions for all sensor predictions are listed as follows:

SENSOR LOCATION	CONTROL POINT	TRANSFER FUNCTION
#1	No prediction	----
#2	W.S. 55.16	1.15
#3	W.S. 55.16	1.00
#4	No prediction	----
#5	W.S. 91.50	1.00
#5 [a]	W.S. 91.50	0.67
#6	No prediction	----
#7	No prediction	----
#8	W.S. 55.16	1.01

Transfer functions were developed using fatigue sensor strain gage element and/or conventional strain gage readings at the instrumented location versus the measured control point strain. Figure 5 shows development of the strain transfer from WS 55.16 to location #8 using strain gage data.

3 Multiplier Setting

The effective FM multipliers developed by Reference 4 laboratory tests were used for response prediction calculations:

Nominal Mult Value	Eff Multiplier (Ref 4, Fig 7-2)
2.5	2.62
3.5	3.42
4.0	4.10 (est)

4 Calibration Data

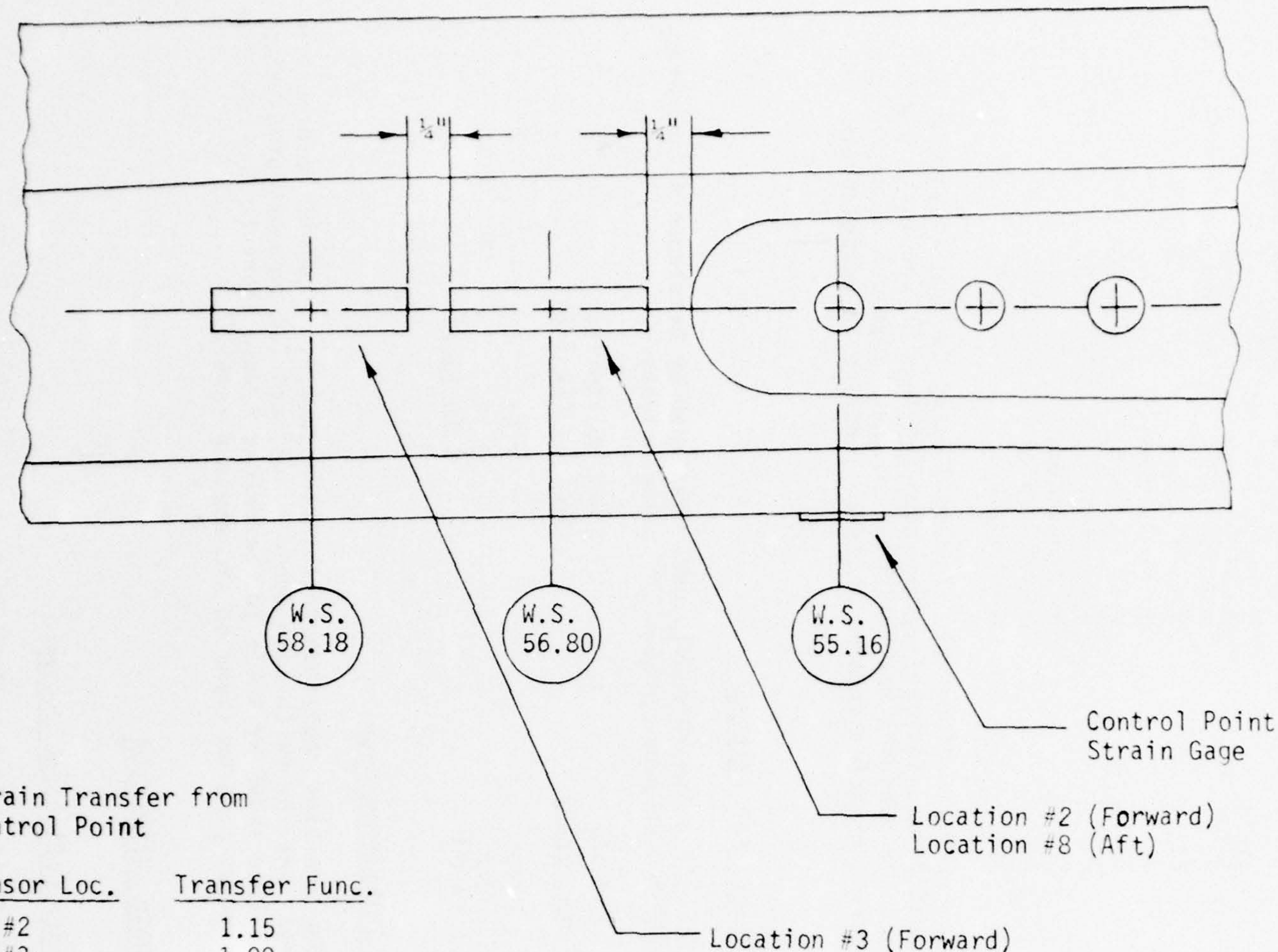
The constant amplitude calibration data developed by Reference 4 laboratory tests for the FM fatigue sensor were used for response prediction calculations. Data shown by Table 18, Reference 4 were input to the response prediction computer program (mean strain assumed zero).

D DATA COLLECTION

1 Data Collection System

Lead wires from individual fatigue sensors were routed to a data collection panel in front of the test article (Figure 3). This data collection panel was developed for Reference 4 laboratory tests, and was designed specifically to read FM fatigue sensors and TG temperature sensors with minimum effort and possibility of error. The data collection

a - Following structural beef-up at W.S. 91.50.



Strain Transfer from Control Point

Sensor Loc.	Transfer Func.
#2	1.15
#3	1.00
#8	1.01

Figure 4 - Lower Front Spar Transfer Functions

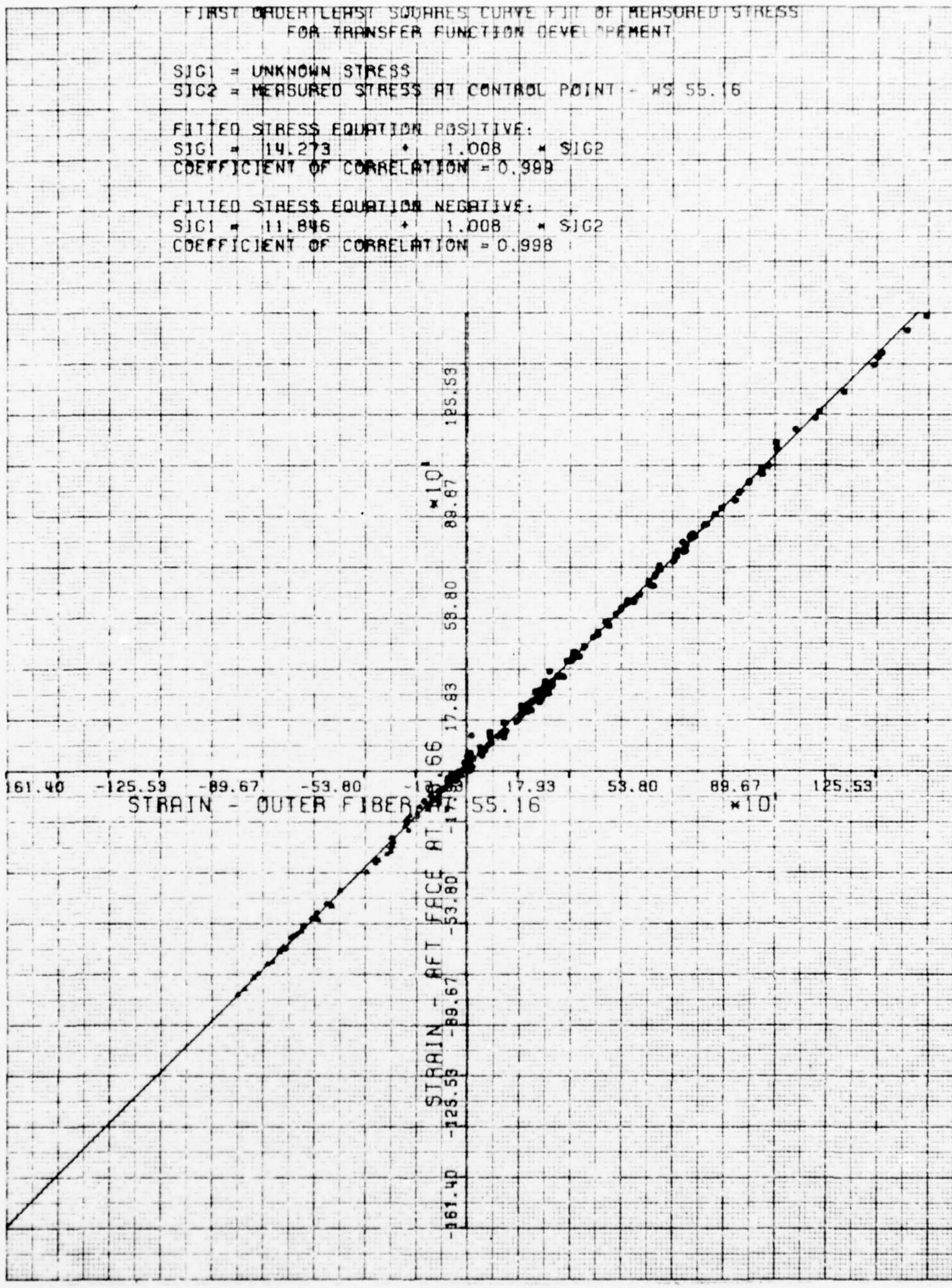


Figure 5
Transfer Function Development

panel contained a switch position for each fatigue sensor and a zero reference (Micro-Measurement S-100-05 precision resistor) for the initial zero adjustment of the readout indicator (Figure 3). In addition, another switch selected the composite sensor (half bridge readout), the fatigue sensor element, or the strain gage element of the FM sensor, as well as switching in the required dummy resistor used in reading the individual sensor elements (quarter bridge readout).

A Vishay Model P-350 strain indicator was connected to the data collection panel to read fatigue sensors and temperature sensors as outlined in Appendix C, Reference 4.

2 Data Collection Procedure

An initial zero resistance reading was recorded for each fatigue sensor prior to test start. Fatigue sensor resistance change was read at approximately 250 test hour intervals (twice per time block) with a more frequent interval for early sensor response (0 - 2000 hours) due to the logarithmic nature of fatigue sensor response. The actual reading interval for fatigue sensor data is listed by Appendix A. Fatigue sensor readings were taken on a non-interference basis and were timed to coincide with test inspections or tape changes on the fatigue test loading system. All fatigue sensor readings were taken with "hydraulics up" on the test article which is a repeatable zero load condition used as a starting and ending point of cycling.

Structure temperature was recorded for each fatigue sensor reading to correct resistance data for temperature effects. The temperature for each reading is noted by Tables A-1 thru A-7, Appendix A.

The resistance of both the composite fatigue sensor and individual elements was recorded for each fatigue sensor reading. This procedure served as a measure of quality control on the data since the difference between individual elements may be used to check the composite reading and the strain gage element should be stable for a repeatable static load condition.

E DATA ANALYSIS

1 Data Reduction

All fatigue sensor data collected from the A-37 final full-scale fatigue test are presented in table form by Appendix A. These data are presented as sensor resistance change (Delta R) which is calculated by subtracting sensor initial zero reading from each test reading and correcting for temperature variations. FM sensor temperature correction data is contained in Reference 4. Sensor resistance change data from Appendix A and corresponding predicted response (when available, Paragraph 2.3) are plotted by structural area in Figures 7 through 14. Figure 6 is a data plot of FM sensor response at location #2 on the preliminary full-scale test (Reference 3) and is included for comparison of preliminary and final tests. 'Test Hours' on the plots refers to sensor test hours, rather than airplane test hours. Figures 7-14 represent 1.12 test safe lives, while Figure 6 represents 1.42 safe lives (The preliminary test safe life was 7013 hours).

Four sensors initially installed at locations #5 and #6 gave abnormal response and are not included in data plots. These sensors were removed from the test article and examined. Air bubbles in the M-16 adhesive produced out of tolerance multiplier performance.

In reviewing fatigue sensor data plots, the local variations of the test spectrum are observed to produce fluctuations in the sensor response rate. However, the block to block sensor response forms a smooth function which may be compared to predicted response and is used for development of calibration curves.

2 Data Comparison

Fatigue sensor response at different structure locations may be compared (same multiplier setting) for a relative indication of strain history severity. Table 2 makes a comparison of sensor response at 1000 test hours for several structure locations. From comparisons of this table and reviewing data plots (Figures 7 through 14), the following comparisons are made for the final full scale fatigue test:

a) Test loading is symmetrical on the test article by noting minimum response scatter RH to LH at all locations.

b) The final full-scale test (training spectrum) is more severe than the preliminary full-scale test (combat spectrum, Reference 3) at the lower front spar, WS 55.16.

c) The lower wing surface (front spar) is more severe than the upper surface at both inboard and outboard locations.

d) Lower front spar, WS 91.50 is the most severe location (prior to beefup).

e) WS 91.50 is approximately equal to WS 55.16 on the upper front spar and is more severe on the lower spar.

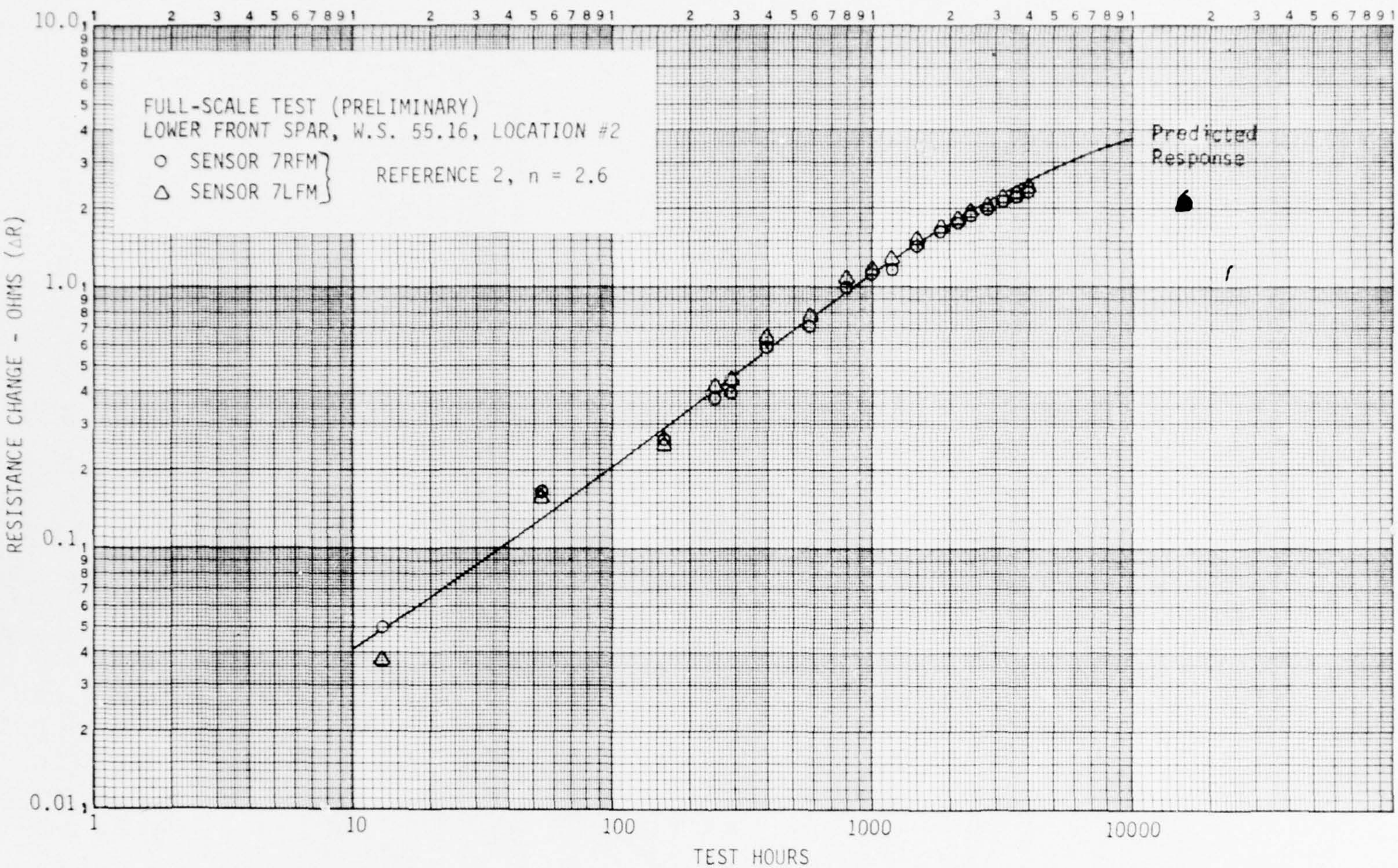


Figure 6 - Preliminary Full Scale Fatigue Test Response - W.S. 55.16

f) Structural beefup on lower WS 91.50 reduces this location to less severity than the upper spar at WS 91.50.

g) Rear spar is less severe than front spar.

NOTE: Data comparison trends indicated by items (c) and (g) were also exhibited by the preliminary fatigue test (Reference 3).

Predicted response for the full-scale test was generally close to actual response.

F CALIBRATION CURVE

Test data from the full-scale test was used to form a calibration curve for comparison with fatigue sensors on operational field aircraft. Field aircraft were instrumented identical to location #8 on the full-scale test. Test data from location #8 were curve fitted using a characteristic fatigue sensor curve shape (constant amplitude data, Reference 4) as shown by Figure 15. Due to variations of severity within the spectrum, the curve fit was based on a smooth fit of block to block fatigue sensor response (500 hour interval).

TABLE 2
COMPARISON OF FULL SCALE TEST RESPONSE AT 1,000 TEST HOURS

LOCATION	MULTIPLIER	ΔR (OHMS)
2 (Prel. Test)	2.6	1.15
2	2.6	1.44
3	2.6	1.05
4	2.6	1.10
5*	2.6	0.85
6	2.6	1.05
8	2.6	1.25
2 (3)	3.5 (4.0)**	2.94
4	3.5	2.15
5	3.5	3.90
6	3.5	2.10
7	3.5	0.28

* Structural beefup installed at this location

** Response at Location #3 with multiplier 4.0 is approximately equal to response at location #2 with multiplier = 3.5 due to strain gradient. (See Figure 2-8, (3.5)(1.15) = 4.025)

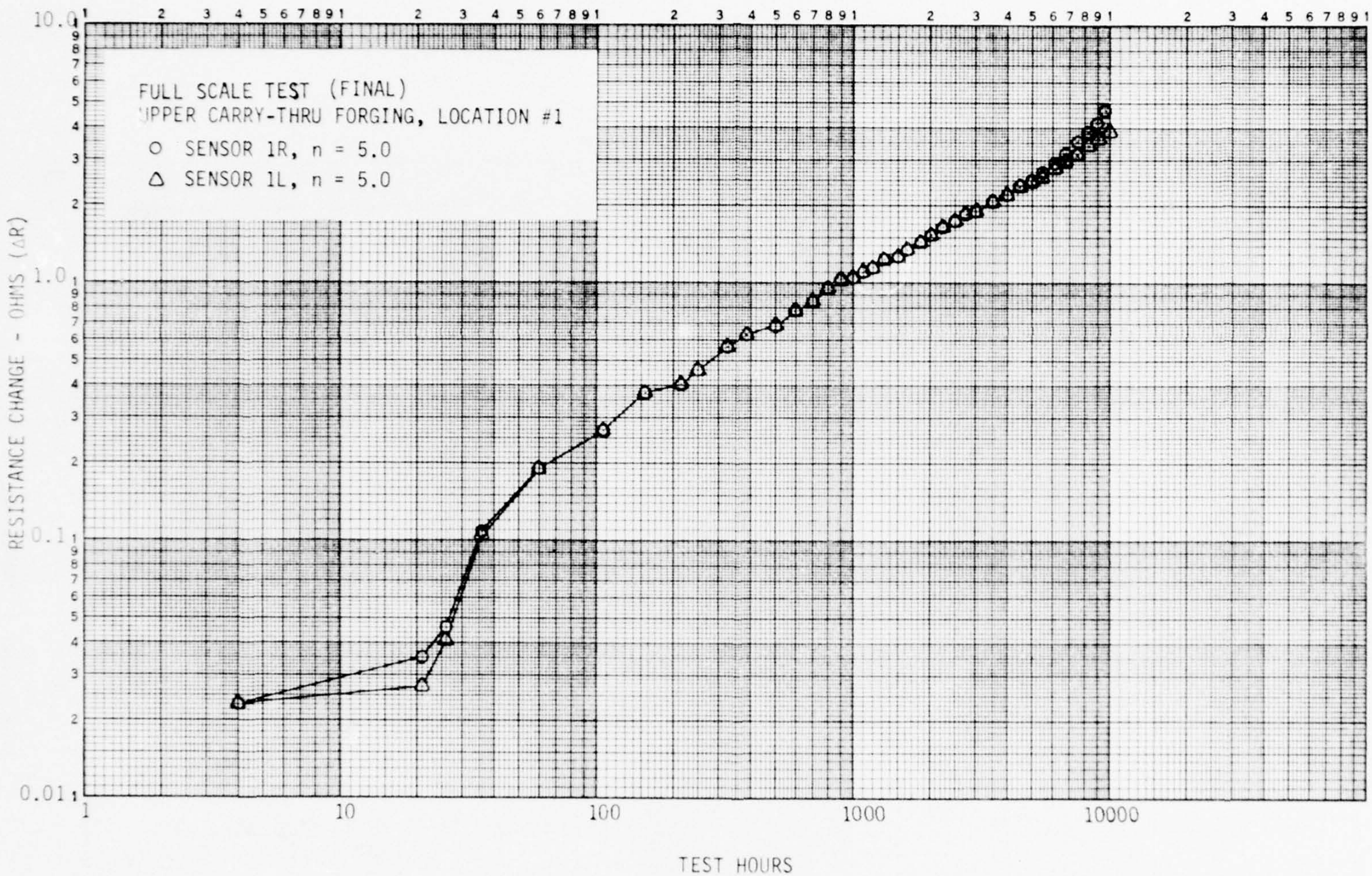


Figure 7 - Upper Carry-Thru Forging - Location 1

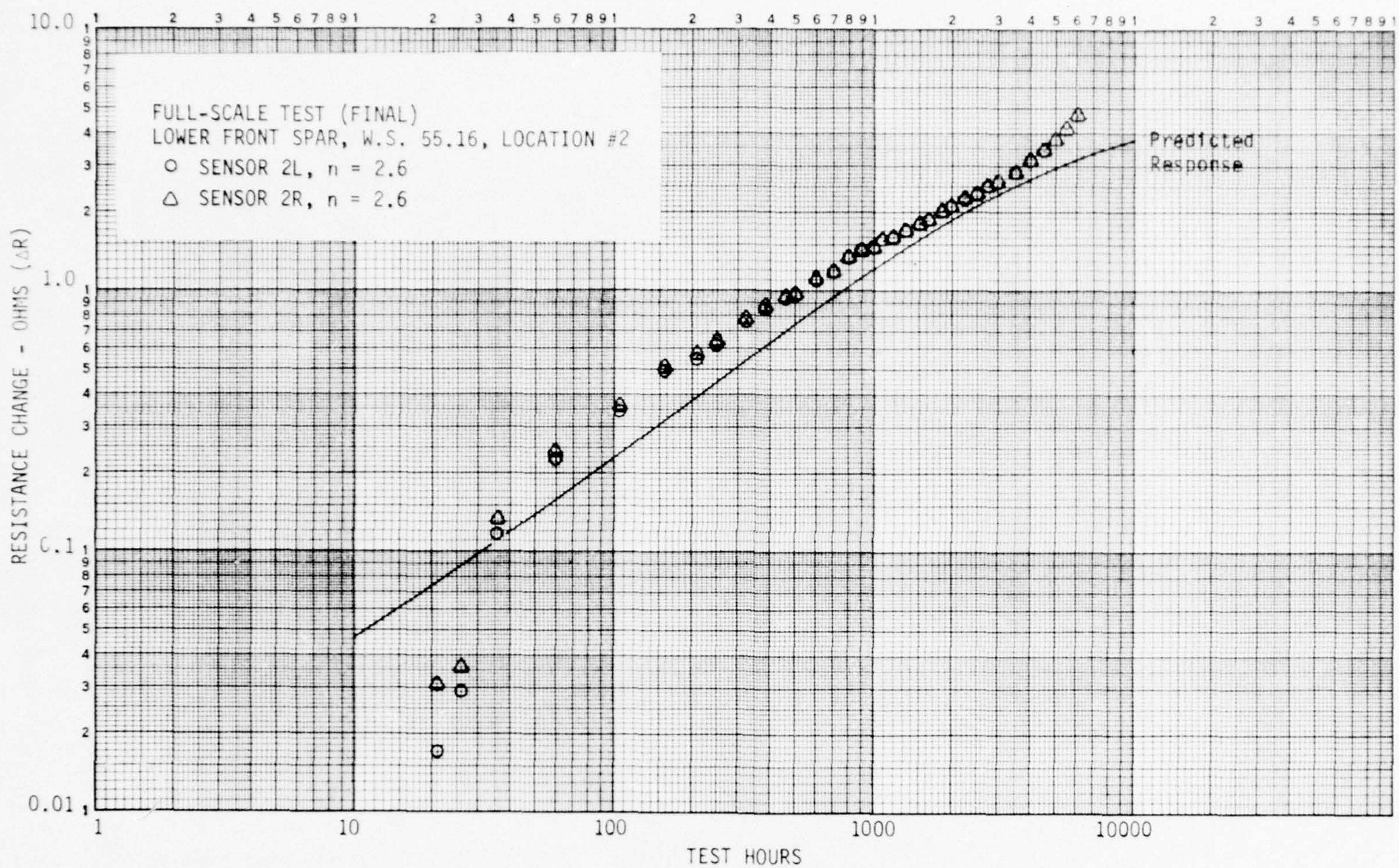


Figure 8 - Full Scale Test Response - Location 2

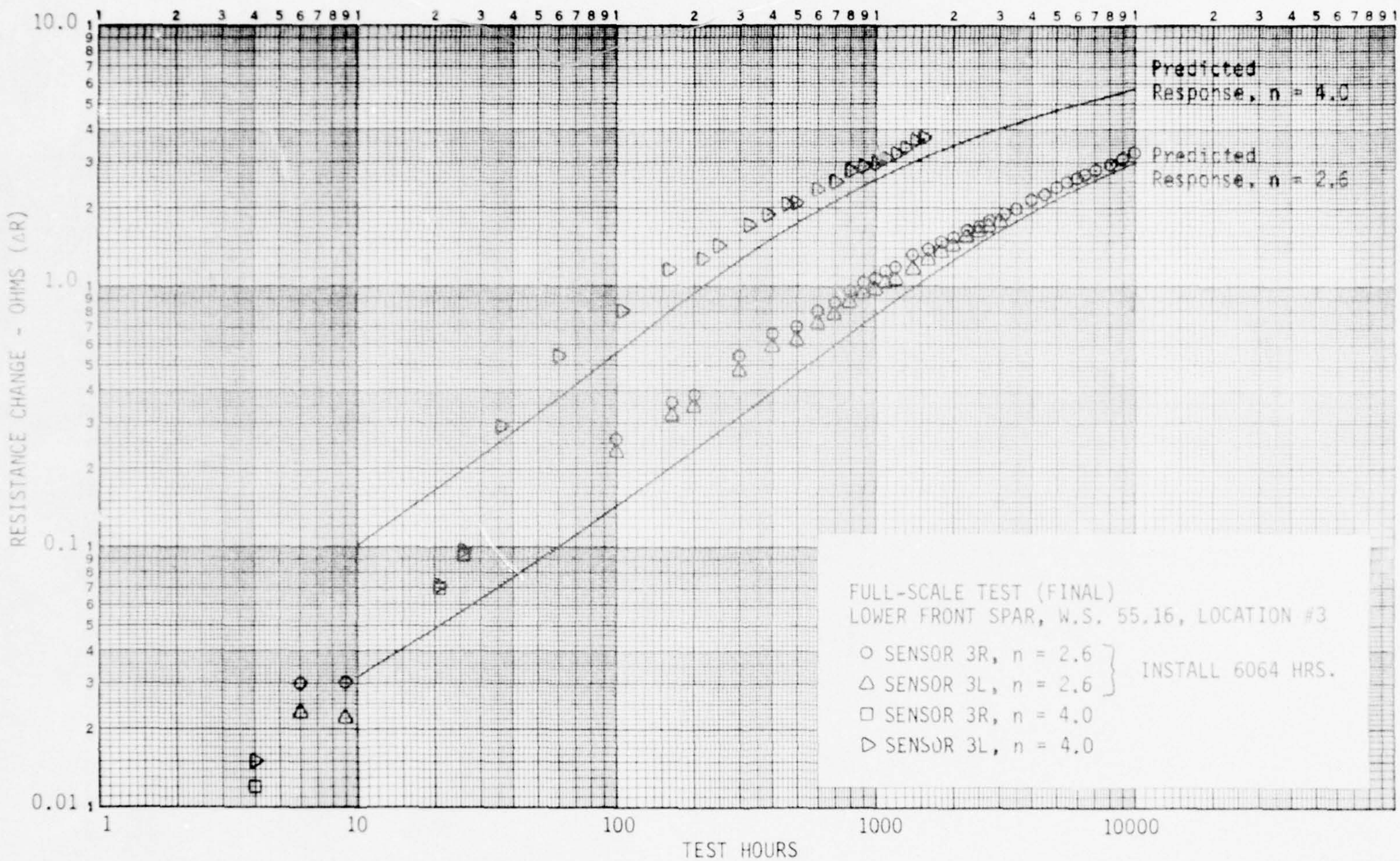


Figure 9 - W.S. 55.16 - Location 3

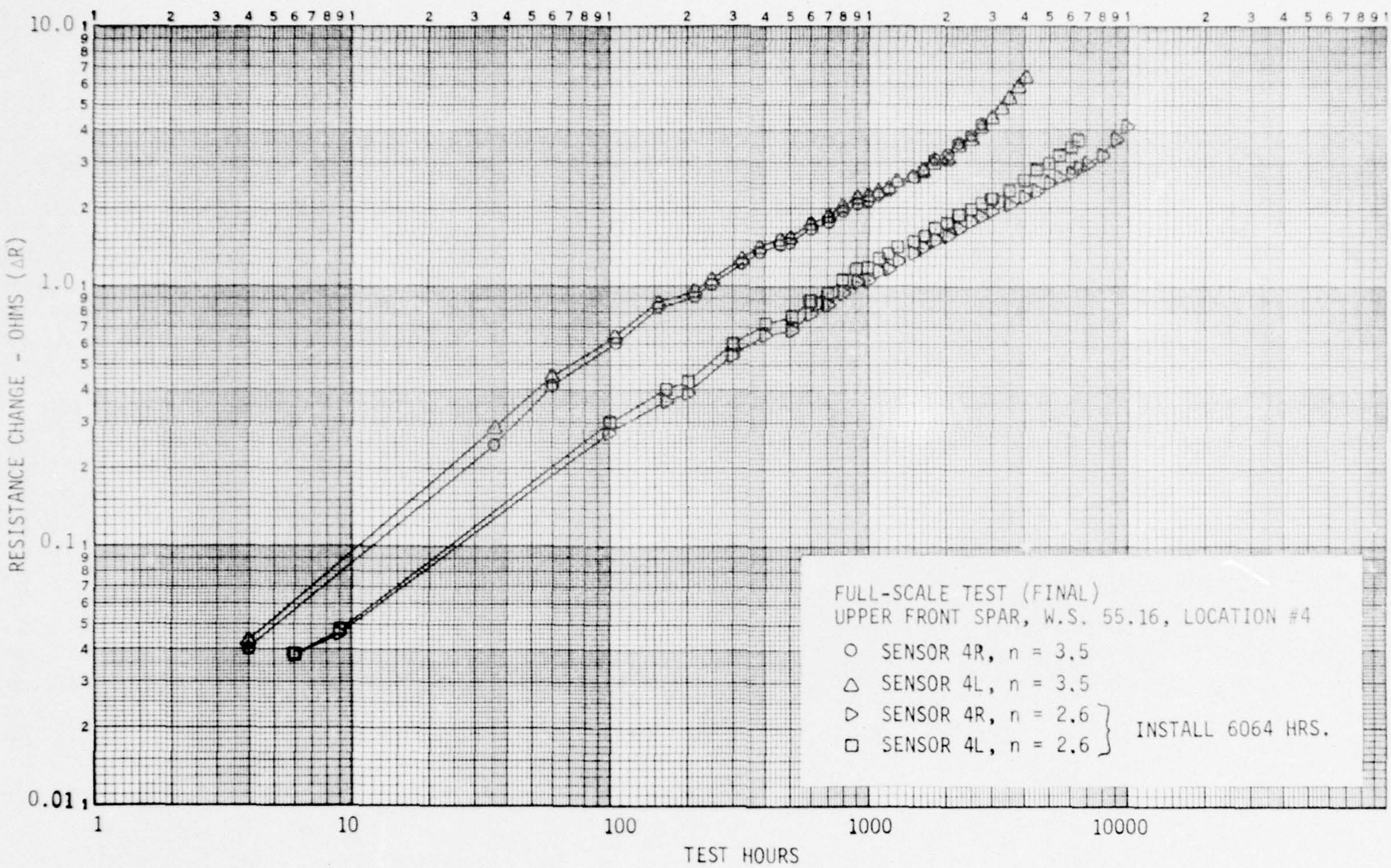
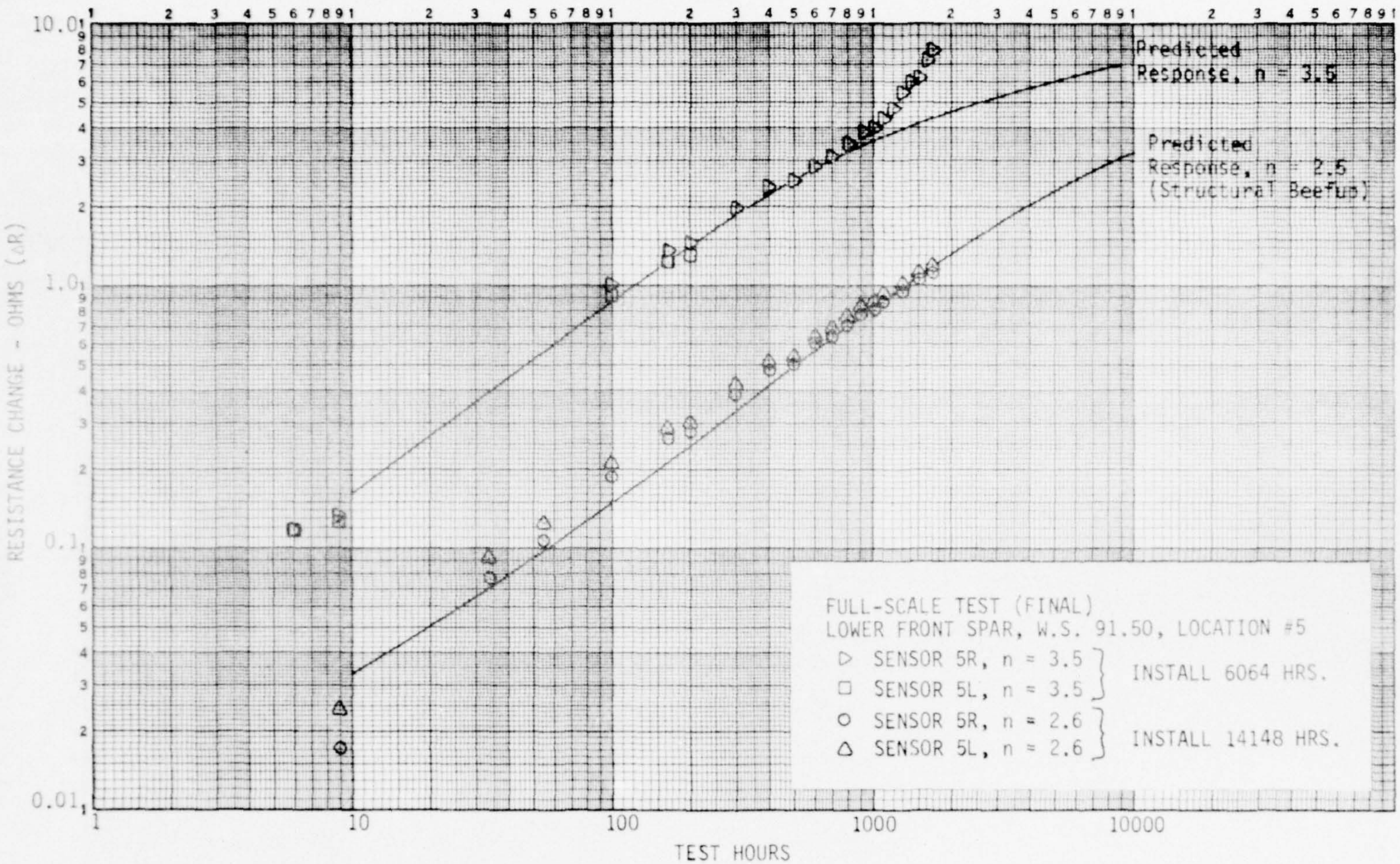


Figure 10 - W.S. 55.16 - Location 4



Note: A structural beefup installed adjacent to this location at 14148 hours with resulting drop in strain

Figure 11 - W.S. 91.50 - Location 5

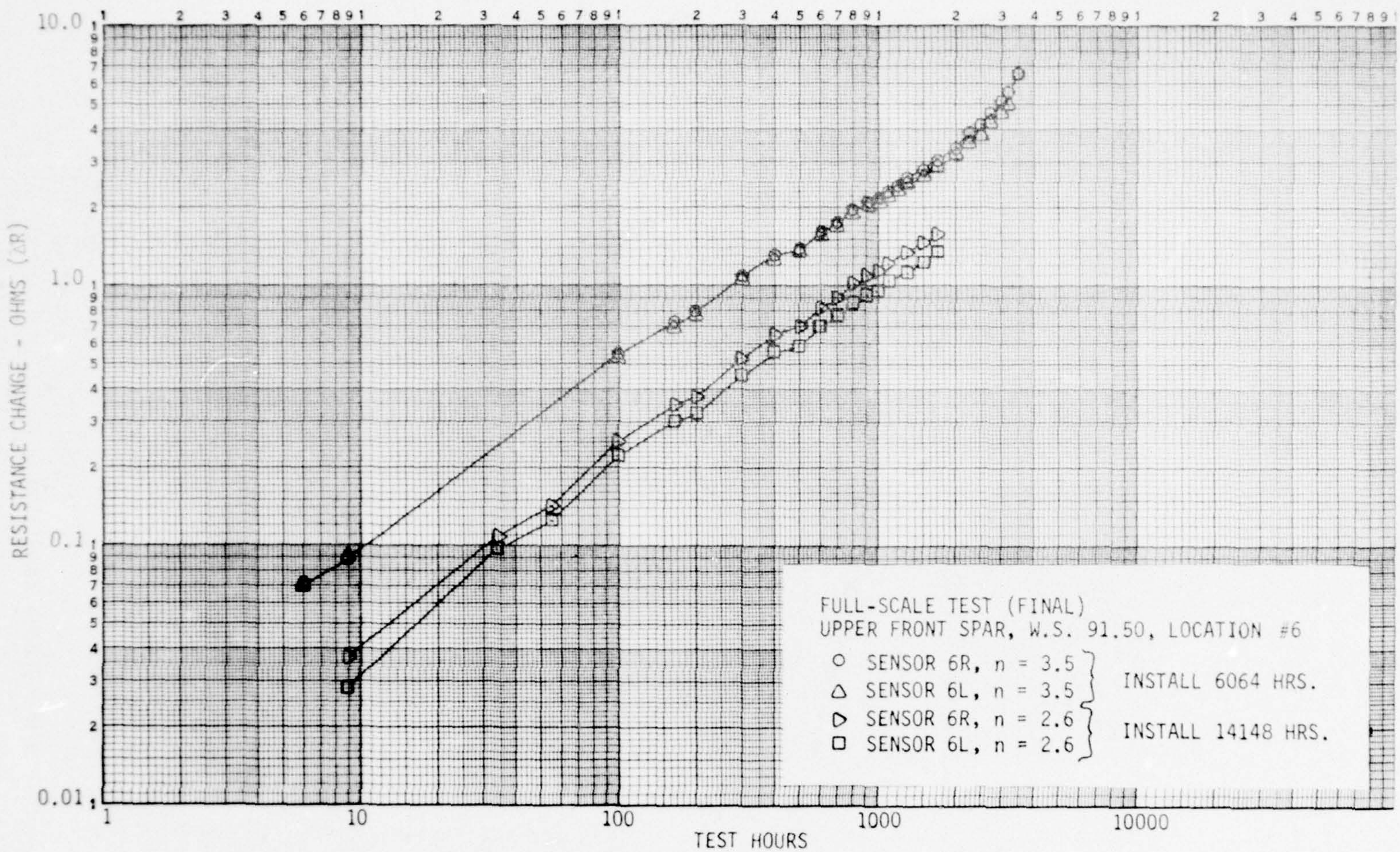


Figure 12 - W.S. 91.50 - Location 6

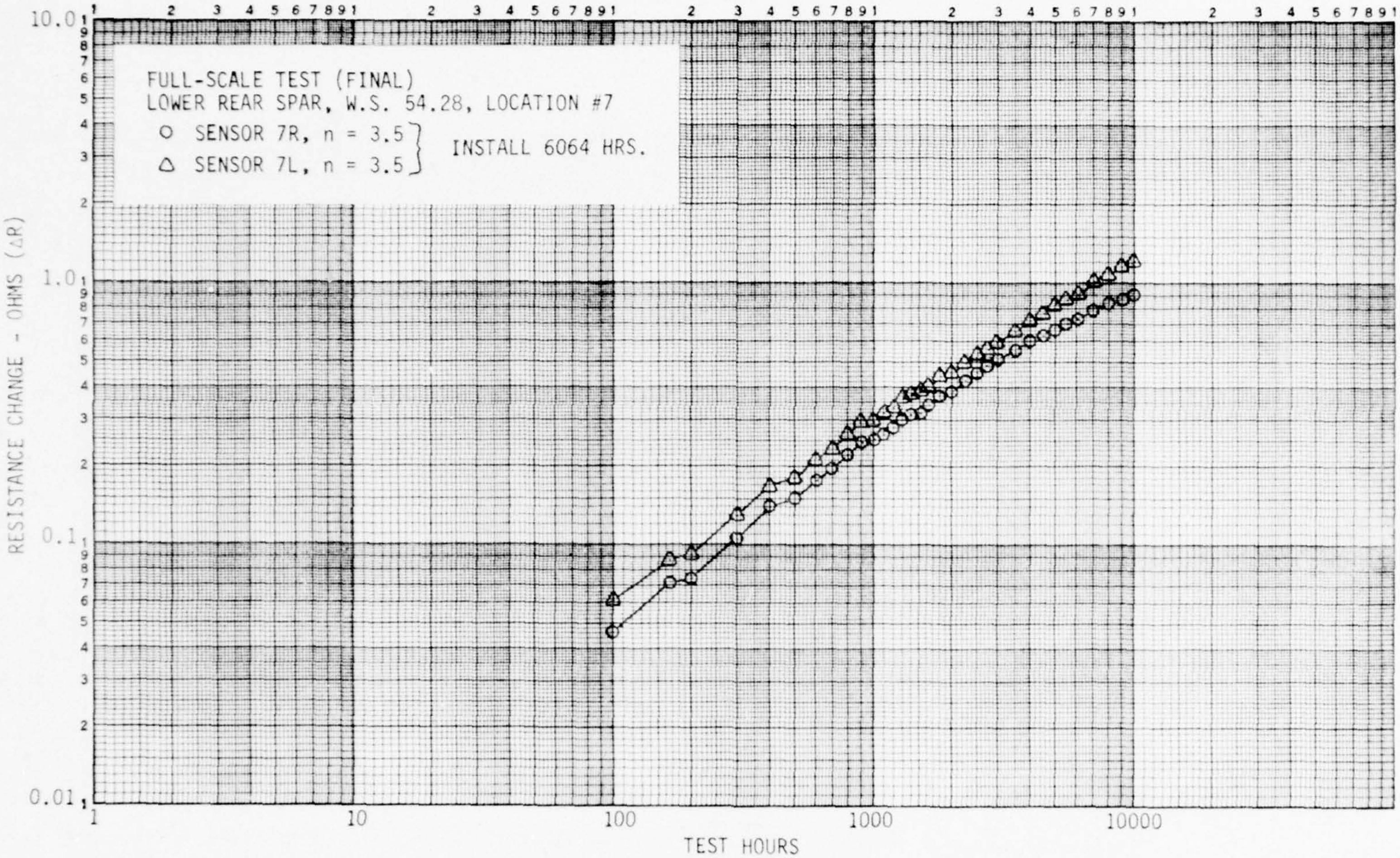


Figure 13 - Lower Rear Spar - Location 7

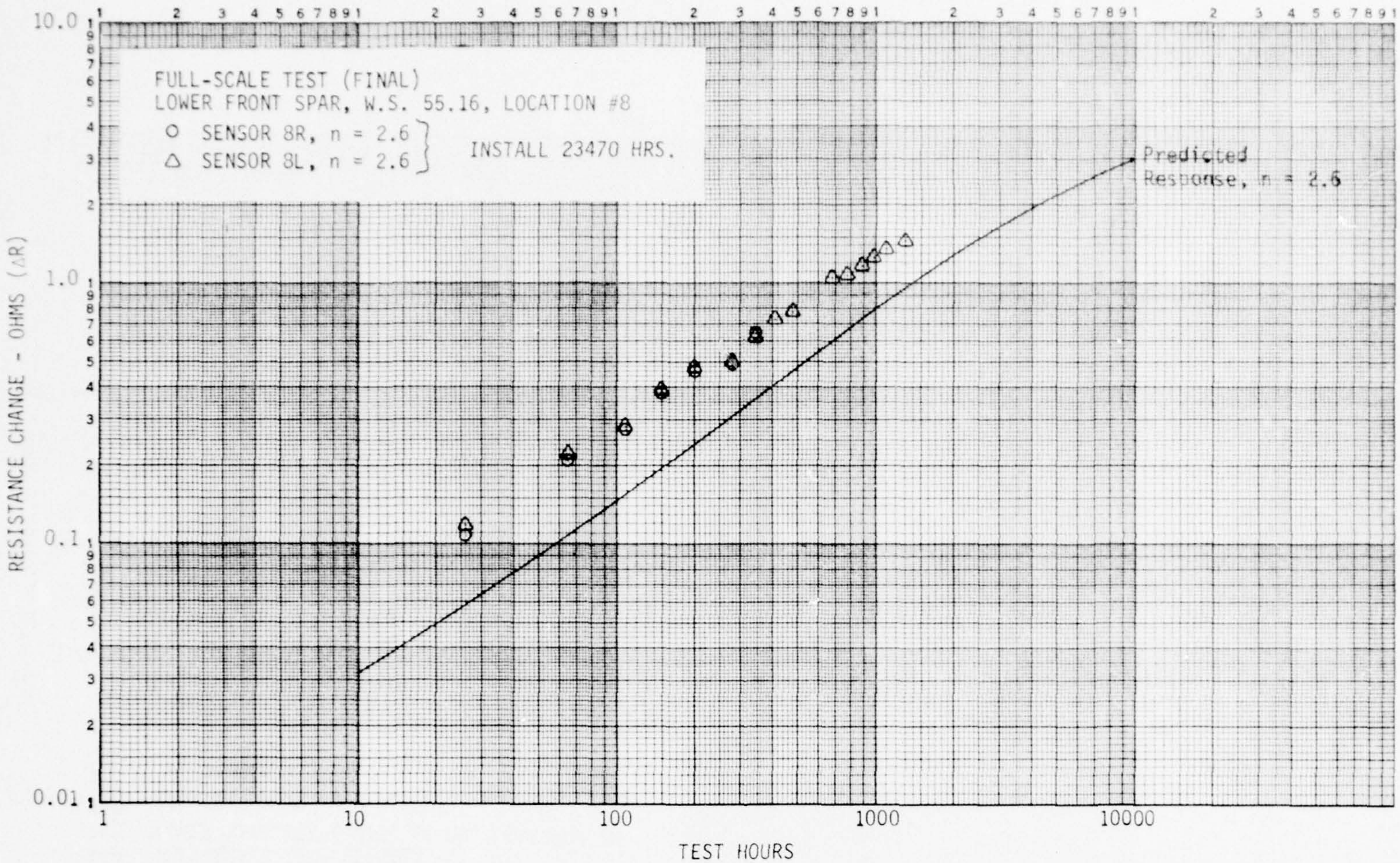


Figure 14 - Lower Front Spar - Location 8

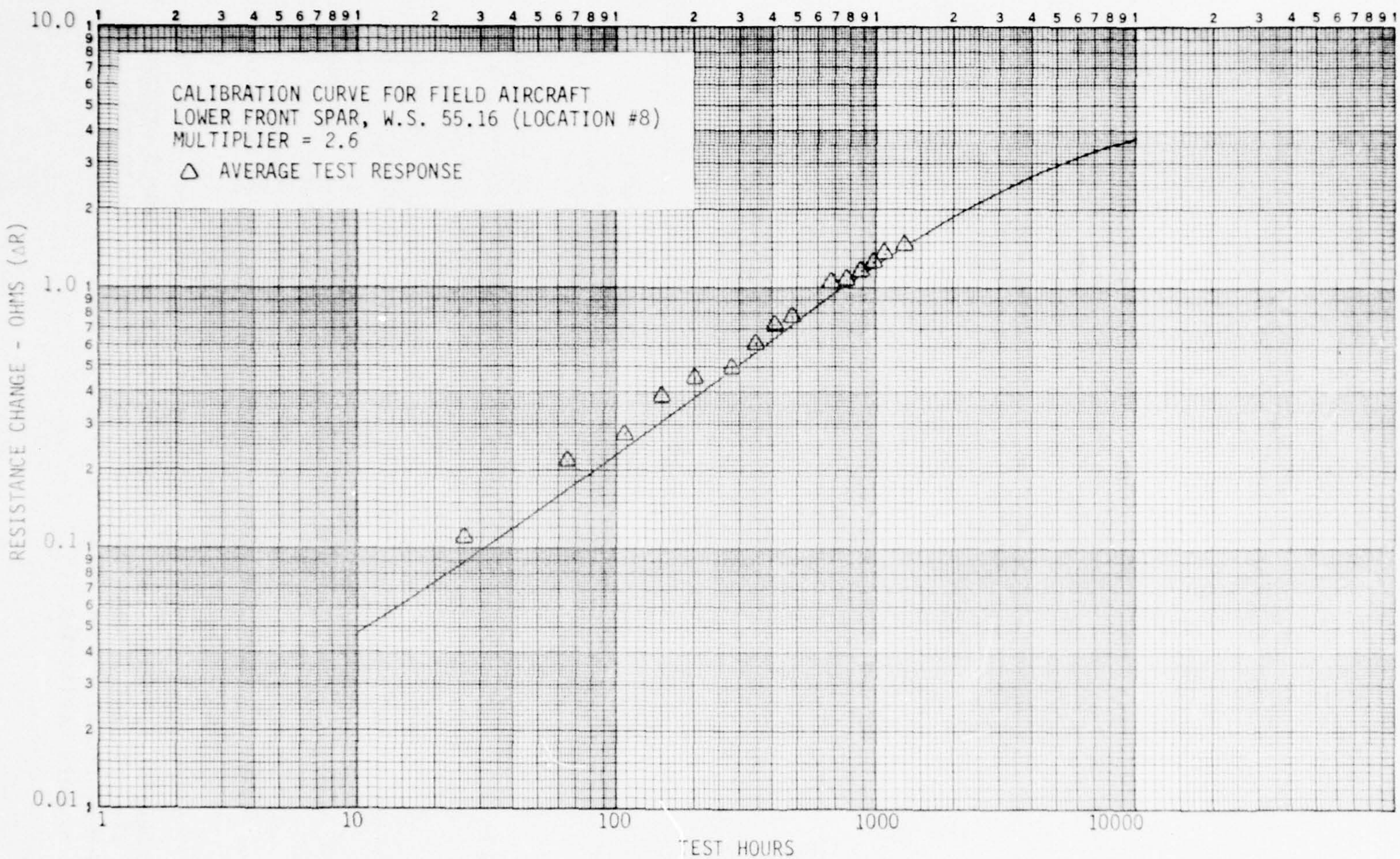


Figure 15 - Calibration Curve For Field Aircraft

SECTION III

FIELD AIRCRAFT FM SENSOR INSTALLATION

A INTRODUCTION

Sixteen A-37B aircraft at three CONUS bases were instrumented with two FM fatigue sensors, one on each wing, at location #8 (Figure 2) and monitored on a quarterly basis for thirty-six months. Fatigue sensors were installed January 1973 by a Cessna Instrumentation Engineer and subsequent quarterly data collection was made by Cessna Fleet Monitoring engineers.

Installation and data collection techniques are similar to those described by Reference 3 preliminary program. Field aircraft response data are compared to full scale test calibration and other operational bases to develop severity of usage trends.

B INSTRUMENTATION

FM fatigue sensors were installed on sixteen CONUS aircraft as follows (all aircraft with ECP 94 wing):

Base	Using Command	Date	No. of Aircraft
Barksdale AFB	AFRES	11-12 Jan 1973	5
England AFB	TAC	13-14 Jan 1973	6
Maryland ANG	ANG	27-28 Jan 1973	5

The three using commands had previously shown usage variations (Reference 3). FM sensors were installed to confirm these trends.

Instrumentation included one Micro-Measurement FM221-02.5L fatigue sensor per wing spar (RH, LH) installed at WS 56.80 (location #8, Figure 2) and one Micro-Measurement TG temperature sensor installed on the LH spar adjacent to the fatigue sensor. A short lead wire was installed from the fatigue sensor to a five pin connector installed in the 4022287 wheel well access panel. Figure 16 shows the fatigue sensor installation kit and Figure 17 shows the wheel well access area for installation and data collection.

Several of the instrumented aircraft had previously been instrumented with Dentronic fatigue sensors by Reference 3 program. In this case, the original inboard Dentronic sensor was removed to make room for the Micro-Measurement sensor while the original outboard sensor was left intact for long term monitoring.

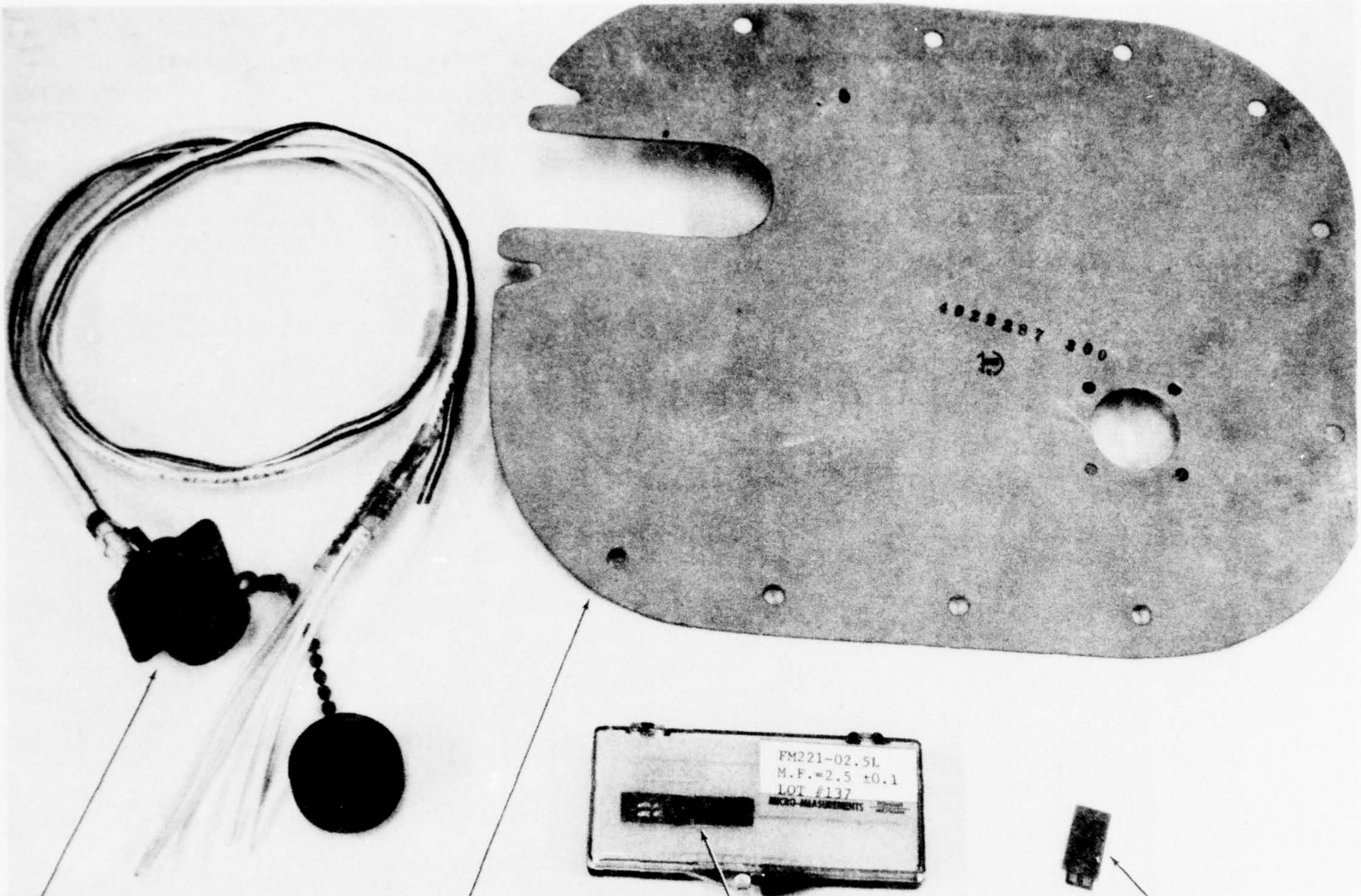


Figure 16 - Field Aircraft Installation Kit

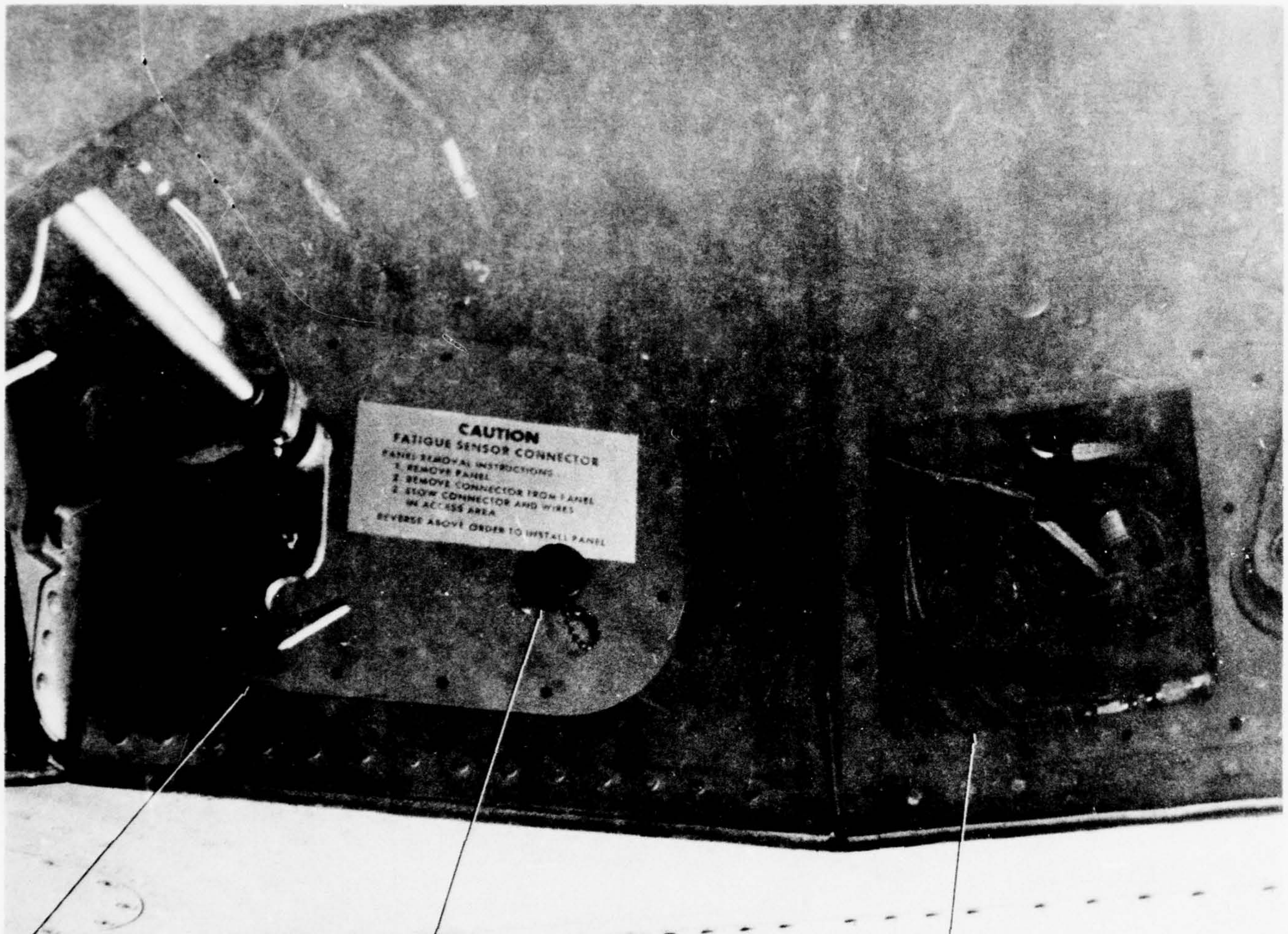


Figure 17 - Wheel Well Access for Fatigue Sensor Installation and Data Collection

Fatigue sensors were installed by a Cessna team (Instrumentation and Fleet Monitoring engineers) with excellent support provided by Air Force personnel at each base. Air Force personnel removed access panels required for access to the front spar and operated ground heaters required to cure the fatigue sensor adhesive.

The Micro-Measurement FM sensor was easier to install than the Dentronic sensors used in earlier programs. Total aircraft downtime was four hours which included:

a) One hour clean spar, mix adhesive, position sensors

b) Two hour adhesive cure using 140° F ground heater

c) One hour wiring and initial zero

The installation procedure is described as follows:

Step 1 - Access to Front Spar

Aircraft were moved to a hangar or maintenance area for the installation work. Air Force personnel provided access to the front spar cap by:

1) Lowering inboard gear door

2) Disconnect gear door actuator and cycle to "gear up" position

3) Remove the 4022389 and 4022287 access panels.

Figure 17 shows the wheel well area with the access panel removed.

Step 2 - Install Sensors

FM sensors were installed using manufacturer's instructions (Reference 6) and using techniques described by Reference 4. This included:

1) Clean spar cap and mark sensor location

2) Install temperature sensor (Micro-Measurement ETG-50DP) adjacent to LH FM sensor using Eastman 910 adhesive (Figure 18)

3) Position FM sensor on spar using a piece of cellophane tape (3M #157) placed across the top of the sensor

4) Mix and apply M-16 adhesive

5) Cure adhesive for two hours at 140°F

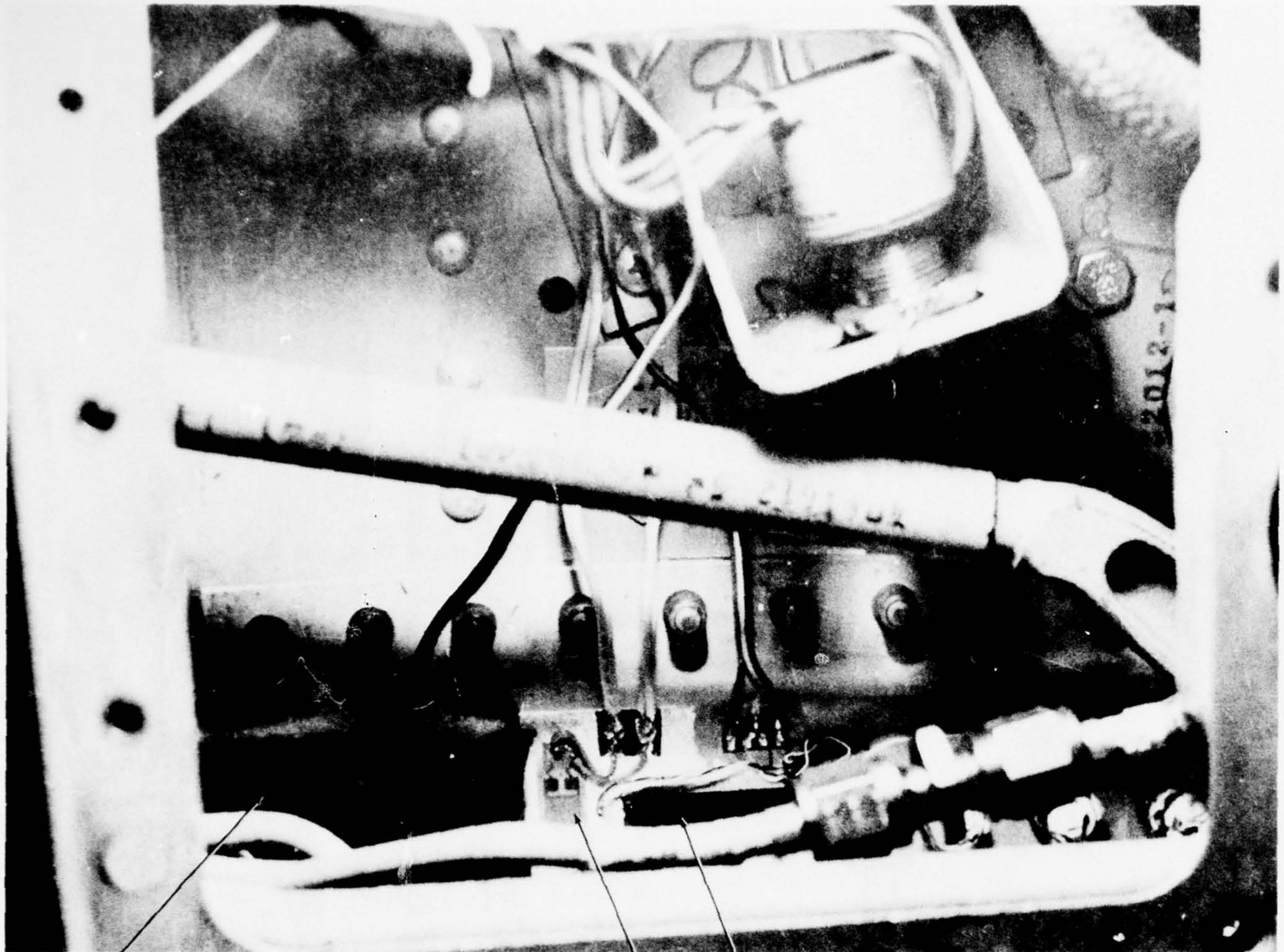


Figure 18 - Instrumentation Prior to Protective Coating

Step 3 - Install Wiring

Sensor wiring consisted of installing short lead wires (approximately 18") from the sensor to a five pin electrical connector installed in the modified 4022287 access panel. Wiring was tied to an existing wire bundle to assure no interference. The LH connector contained leads from both the fatigue sensor and temperature sensor using three and two pins respectively. A placard cautioning handling of the electrical connector was installed adjacent to each connector as shown by Figure 17.

Step 4 - Apply Protective Coating

The FM sensor wiring/solder joint and TG temperature sensor were coated with "M-Coat A"[a] gage protective coating and a pad of BLH Barrier "E"[b] for electrical and mechanical protection. The FM sensor was not covered to avoid changing the multiplier performance (the rubber-like encapsulating material of the FM sensor multiplier assembly provides a measure of protection).

Step 5 - Sensitivity Check

To check operation of the FM sensors after installation, a store load was placed on the outboard pylon (WS 191.50). Reading the FM sensor as a strain gage (Gage Factor = 2.0) -60 to -80 micro strain response was recorded from all sensors (static load varied from 155# - 175#).

Step #6 - Zero Reading

An initial zero resistance reading was recorded for each fatigue sensor; all sensors were within tolerance (100 $\pm$ 1.0 ohms) for this reading. Reference data consisting of aircraft loading configuration, ambient temperature and total airframe hours were also recorded. Initial zero reading data for the sixteen instrumented aircraft are listed by Tables A-8 thru A-23.

---

[a]M Coat A - an air drying liquid polyurethane protective coating intended for strain gage applications, manufactured by Micro-Measurements, Romulus, Michigan.

[b]BLH Barrier E - A neoprene and rubber polyme patch type protective coating which provides waterproofing and mechanical p otection for strain gages, manufactured by BLH Electronics, Weltham, Massachusettes.

Step 7 - Reassemble Aircraft

Aircraft were returned to the Air Force for reassembly and flight status.

C DATA COLLECTION

1 Data Collection System

The field data collection system used the following elements:

a) Vishay Model P-350 indicator with a gage factor setting = 9.82 to produce a direct reading of ohms resistance.

b) A precision 100 ohm resistor for zero reference (mounted on plug-in block to fit Vishay indicator).

c) A three conductor cable lead wire with plug to fit receptable installed in wheel well.

d) A temperature sensor signal conditioning network for Vishay indicator with leadwire and plug.

e) A dry bulb thermometer to record ambient temperature.

The hand held probe system used by Reference 3 and Reference 7 programs for fatigue sensor resistance readings on field aircraft was discarded in favor of a five pin plug receptacle mounted in the wheel well. The probe system worked satisfactorily for two contact points as required by Dentronic sensors but was less than desirable for three contact points required by the Micro-Measurement FM sensor. The plug system was employed with improved accuracy of data and ease of data collection. Use of a five pin plug allowed the fatigue sensor and temperature sensor on the LH wing to share a common plug.

The temperature sensor readout used a Micro-Measurement LST network to adapt TG temperature sensor output signal to the Vishay P-350 indicator. A direct reading of temperature (^{o}F) was indicated with 0.1^{o}F resolution.

Reference 7. - "T-37B Fuselage-Empennage Scratch Gage and Fatigue Sensor Study", Cessna Report 318B-7319-030, dated 29 March 1974.

2 Data Collection Procedure

Fatigue sensor data collection on field aircraft required approximately five minutes per aircraft with the following activities:

a) Zero the Vishay P-350 indicator by plugging in the "zero block" (Item b, Paragraph 3.3.1) and adjusting the indicator null balance (gage factor = 9.83).

b) Connect Vishay indicator to plug receptacle in wheel well (RH and LH) and read fatigue sensor resistance (balance indicator). One micro-strain ($\mu\varepsilon$) indicated equals 0.001 ohms, e.g., a +243 indication would be +0.243 ohms.

c) Recheck indicator zero after reading fatigue sensors.

d) Connect Vishay indicator with temperature network to the LH wing plug and read structure temperature (direct reading ^{o}F). Note: Gage factor = 2.00.

e) Record supporting data (aircraft hours, ambient temperature, loading configuration, date).

3 Field Data Collection

Fatigue sensors were read by Cessna Fleet Monitoring engineers on an approximate quarterly interval. Reading activities were coordinated with Air Force personnel at each base who provided access to the aircraft. Fatigue sensor readings were conducted on a noninterference basis with data collected between flights or during normal aircraft downtime.

The FM sensor features strain and temperature compensation (Reference 4), which allows fatigue sensors to be read with a variety of aircraft load configurations and ambient temperatures. However, a repeatable load configuration was used for early fatigue sensor readings (if available) to minimize static load effects on small resistance changes (see Reference 4, Paragraph 7.4).

Two of thirty-two sensors installed were found to be defective during field data collection. In both cases (aircraft 70-1291, 69-6833), the fatigue sensor strain gage element was found to be erratic. These failures are typical of those encountered during the Reference 4 laboratory test program (10% premature failure rate for this test series).

Tables A-8 through A-23 list field data collected from 12 January 1973 through January 1976.

4 Data Collection Problems

The major difficulty encountered in fatigue sensor data collection was fatigue sensor wiring disconnected or damaged as noted by Tables A-8 through A-23 (wiring for seven of thirty-two sensors installed was damaged).

Wiring damage occurred primarily during the ECP 171 modification activity (contractor team) and normal Air Force phase inspections. The problem was isolated to the fatigue sensor electrical connector installed in the 4022287 access panel. In spite of a placard to the contrary (Figure 17), the panel was being removed without removing the connector (wiring disconnected by jerking).

It became apparent that the connector location was a poor selection. The previous fatigue sensor wiring for Reference 3 program was never damaged (over 1,000 hours operation) with the connection point on the wheel well web adjacent to the access panel. The lesson to be learned was that of keeping fatigue sensor wiring and connections out of high maintenance traffic areas.

The following modification to the fatigue sensor lead wire routing and electrical receptacle location has been developed:

a) Moving the electrical connector from the access panel to upper wheel well (mount with existing tooling hole).

b) Bonding fatigue sensor lead wire to spar cap (6 inch adjacent to fatigue sensor) using EC 1300 contact cement.

Damaged fatigue sensors on Maryland ANG aircraft were repaired or replaced. These aircraft received the wiring modification.

The six aircraft stationed at England AFB were transferred in August 1974, 69-6366, 6367, and 6369 to Grissom AFB, 69-6368 to Youngstown, 69-6370 to Hancock, and 69-6371 to Maryland ANG.

D DATA ANALYSIS

1 Data Reduction

Fatigue sensor data collected from A-37 field aircraft are presented in Table form by Appendix A (Table A-8 through A-23). These data are presented as sensor resistance change (Delta R) which is calculated by subtracting sensor initial zero reading from each field data reading and correcting for temperature variations (see Reference 4 for FM sensor temperature correction data). All temperature corrections were small (smaller than anticipated before Reference 4 program) and did not measurably affect sensor response data.

Field data are plotted by base location and compared to full-scale test calibration and predicted response using a scratch gage measured spectrum. Figures 19 through 22 present field data plots and respective comparisons. The scratch gage measured spectrum for each is presented by Appendix B; response predictions are consistent with methods and techniques used for the full-scale test (Paragraph 2.3).

2 Data Trends and Observations

Field aircraft fatigue sensor response is compared in terms of position above or below reference data for an indication of operational severity. Data points above reference indicate greater severity of cumulative strain history while points below indicate less severity of cumulative strain history than that associated with the reference data. The following paragraphs discuss A-37B field aircraft severity trends resulting from fatigue sensor data.

a Individual Aircraft Trends

Individual aircraft response data, figures 19 through 21, indicate individual aircraft sensors (RH and LH) tend to track together. Early sensor response among individual aircraft at a given base is scattered but tends to converge as flight hours are cumulated. This pattern indicates local variations in individual aircraft usage severity and data scatter with convergence on the aircraft user operation spectrum as the usage sample increases, which supports the assumption that usage is ergodic.

Some of the fluctuations (scatter) in early sensor response (below 0.1 ohm) are due to sensitivity to ambient temperature (temperature correction applied) and static load variations with small resistance changes. Imperfections in strain and temperature compensation for small FM sensor resistance changes are discussed by Reference 4.

b Operational Base Trends

A variation of severity between bases (aircraft users) is apparent by examining Figures 19 through 21. Figure 22 shows medial response lines for the three bases. Bases are listed in order of decreasing severity:

BASE	USER
England AFB (Grissom)	TAC
Maryland ANG	ANG
Barksdale AFB	AFRES

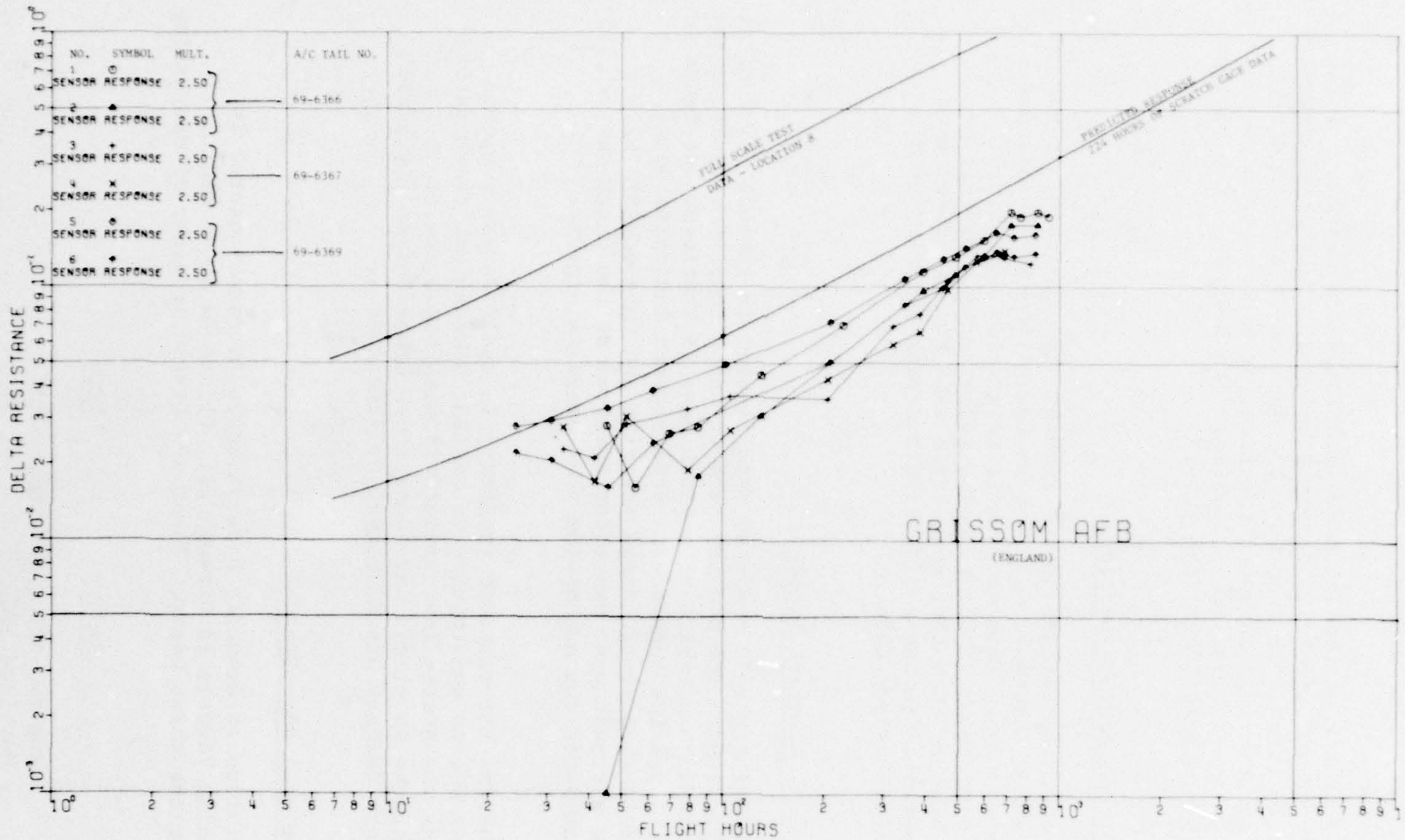


Figure 19 - Fatigue Sensor Field Data - Grissom AFB

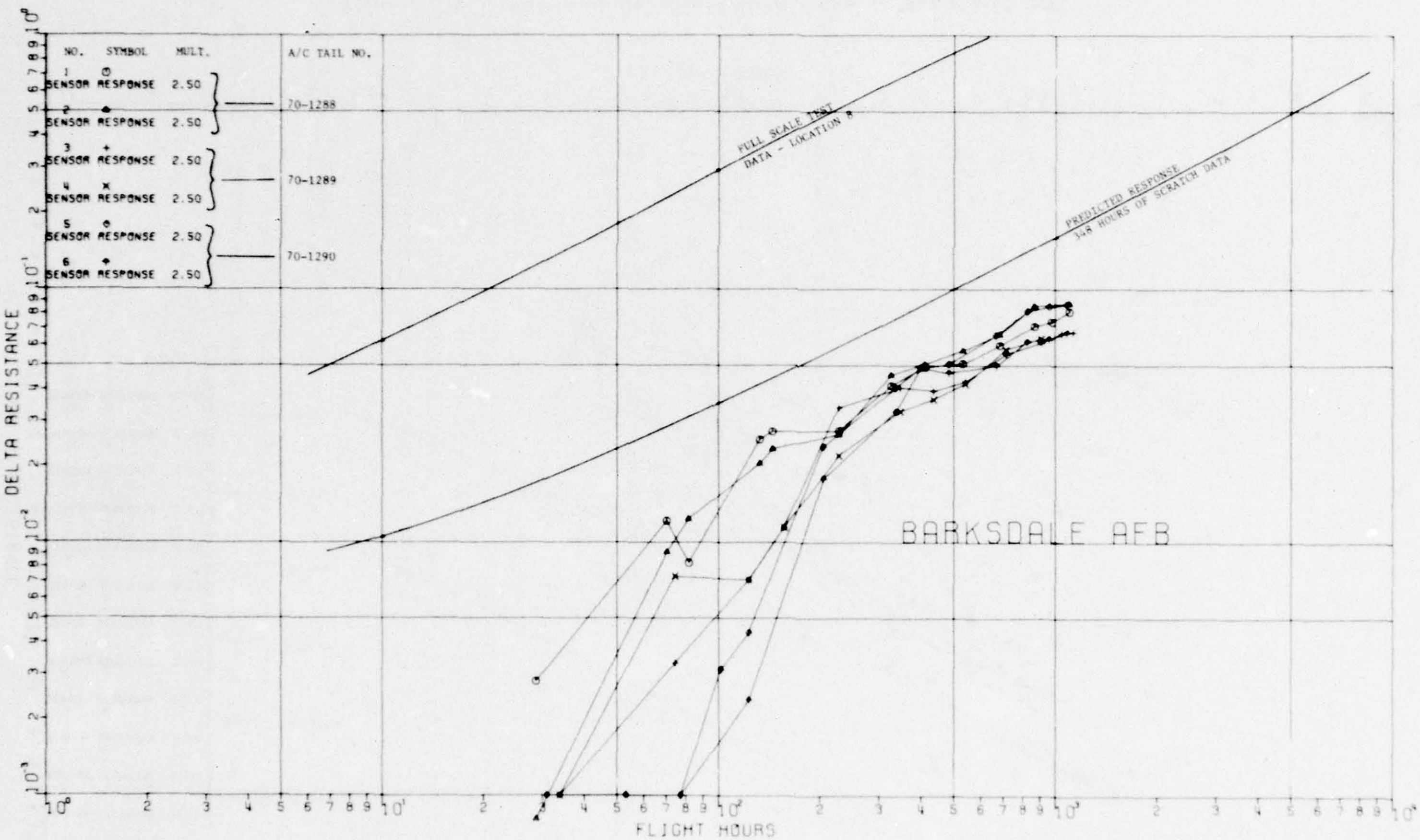


Figure 20 - Fatigue Sensor Field Data - Barksdale AFB

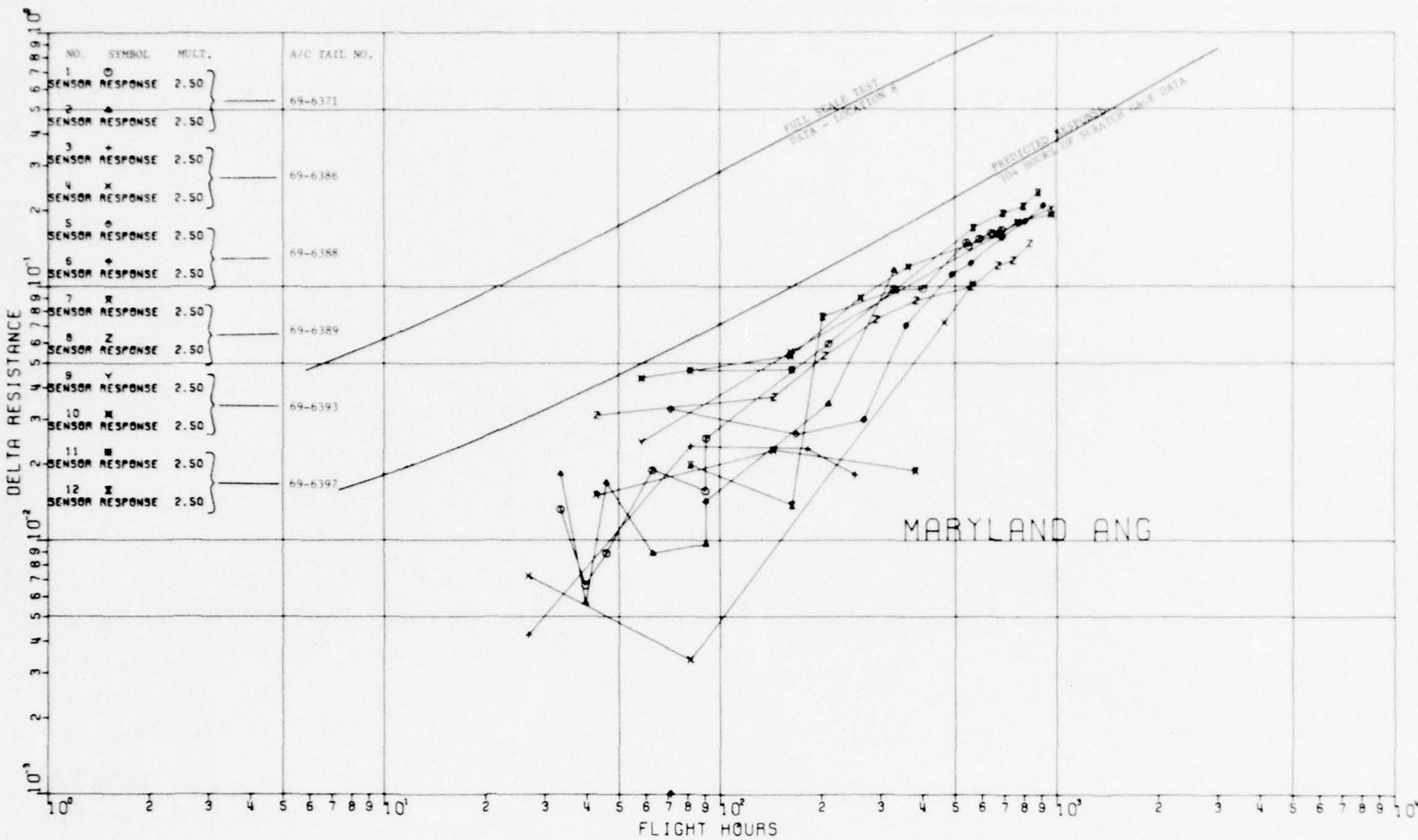


Figure 21 - Fatigue Sensor Field Data - Maryland ANG

SCRATCH GAGE RELATIVE FATIGUE DAMAGE RATES (REFERENCE 8)

Base	Flt. Hours Reduced	Relative Severity* (Base/Test)
Test	---	1.0
England	224	0.4
Maryland	304	0.37
Barksdale	348	0.156

* Comparison of fatigue damage rates at W.S. 55.16 lower front spar cap

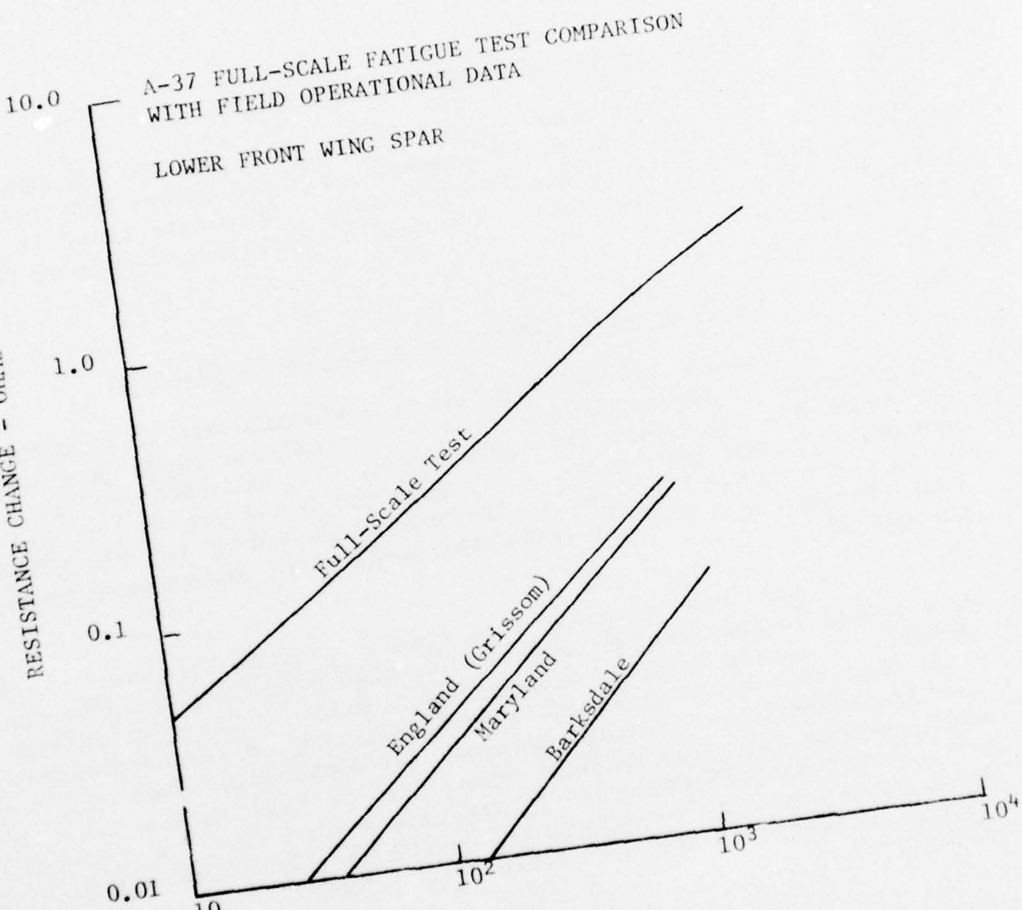


Figure 22
Field Aircraft Response Comparison with Full Scale Test

SCRATCH GAGE RELATIVE FATIGUE DAMAGE RATES (REFERENCE 8)

Base	Flt. Hours Reduced	Relative Severity* (Base/Test)
Test	---	1.0
England	224	0.4
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Barksdale	348	0.156

* Comparison of fatigue damage rates at W.S. 55.16 lower front spar cap

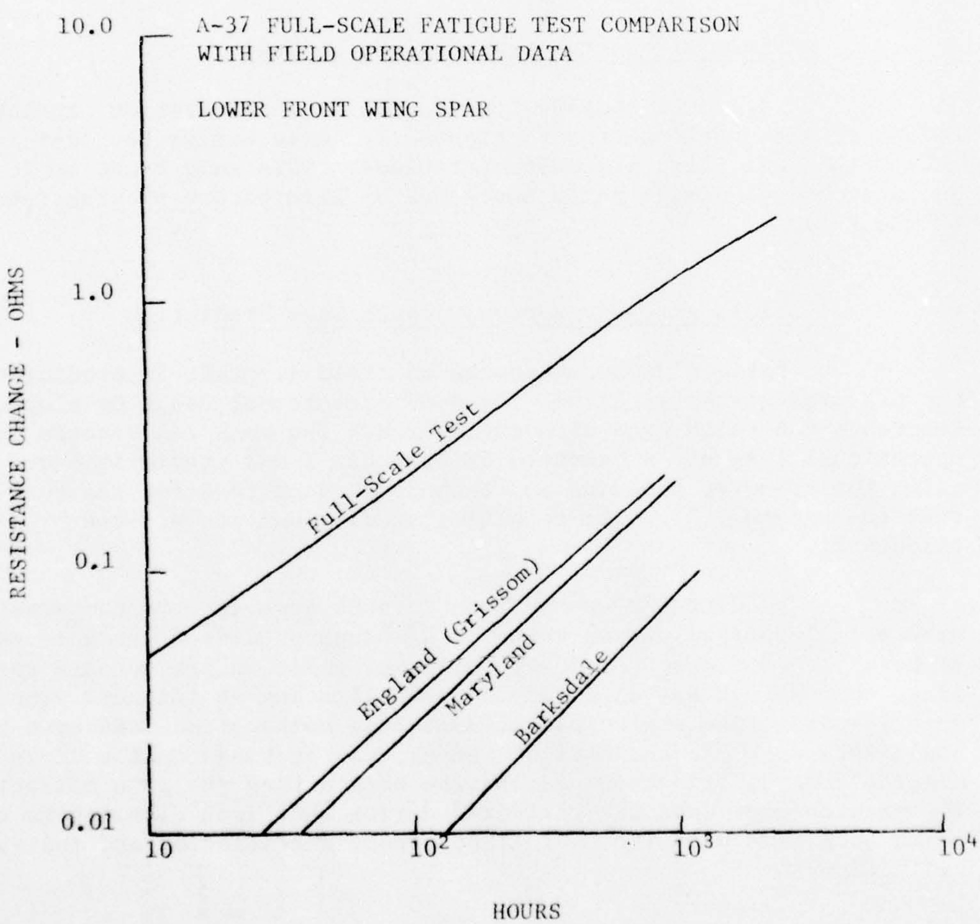

Figure 22
Field Aircraft Response Comparison with Full Scale Test

Proportions of fatigue sensor response suggest Maryland usage to be slightly less than England/Grissom and Barksdale to be considerably less than both of the other bases. This severity trend is the same as that developed by Reference 3 fatigue sensor instrumentation. Also the trends are consistent with scratch gage damage rates developed by Reference 8 program (see Figure 22).

c <u>RH to LH Wing Trends</u>

A comparison of RH versus LH sensor response shows little bias in data; the LH wing tends to be slightly higher at all bases. This data indicates the effects of unsymmetrical loading and flight maneuvers are small on front spar strain history.

d <u>Field Aircraft Versus Full-Scale Test</u>

Figure 22 compares full-scale test calibration developed by Figure 15 with field aircraft response at three bases; the test is more severe than all field aircraft operations. This same trend is indicated by scratch gage damage rates developed by Reference 8 program (see Figure 22 and B-2).

e <u>Field Aircraft Versus Scratch Gage Prediction</u>

Fatigue sensor response on field aircraft is predicted using the measured strain spectrums for A-37 operational usage developed by Reference 8 scratch gage data collection. The measured spectra for each operational base are documented by Appendix B and predictions are made using the transfer function and techniques described for the full-scale test (Paragraph 2.3). The resulting predictions are plotted by Figures 19 through 21.

Predicted response from scratch gage spectra compares favorably with actual fatigue sensor response although predicted tends to run slightly higher. It should be noted some bias may exist in the scratch gage spectra since that effort was directed toward collecting an adequate sample of each signification store load-mission code combination used by a particular base (Reference 8); the fatigue sensor data is based on the store load-mission code distribution used by the base during the data collection period. The scratch gage data was collected during the first nine months of 1973 which coincides with the FM fatigue sensor installation and initial data collection.

Reference 8. - "Fatigue Damage Rates of Individual Mission Type-Store Load Configuration", Cessna Report 318E-7419-028, 13 January 1975.

Another comparison of scratch gage prediction versus fatigue sensor actual response was made by Reference 7 for the T-37 canopy rail. Both of these cases (Reference 7 and this report) tend to demonstrate fatigue sensor response on field aircraft is compatible with the measured strain spectrum of the scratch gage.

E FIELD PROGRAM RESULTS

a) Sixteen aircraft at three CONUS bases were instrumented with two FM fatigue sensors per aircraft on the lower front spar.

b) Collected 13700 hours of data during thirty-six months.

c) A comparison of field aircraft data with the final full-scale test indicates the test is more severe.

d) Usage severity trends per operational base are indicated and are compatible with scratch gage damage rates per base.

e) Predicted fatigue sensor response using a measured scratch gage spectrum compares favorably with actual fatigue sensor response per base.

SECTION IV

FIELD AIRCRAFT LONG TERM INSTALLATION

A INTRODUCTION

The Reference 3 program instrumented sixteen A-37B aircraft at three CONUS bases with four Dentronic SAP fatigue sensors each and monitored these sensors from 24 July 1971 to 3 May 1972. The Dentronic SAP sensor was the primary fatigue sensor evaluated by the original Reference 3 program while the current program is evaluating the Micro-Measurement FM sensor. However, several of the original Dentronic sensors have been monitored by the current program for an additional twenty-four months as a measure of sensor longevity.

B DATA COLLECTION AND ANALYSIS

The majority of original Dentronic fatigue sensors were made unusable by aircraft transfer or removal to install new FM fatigue sensors as noted by Paragraph 3.2. However, four outboard sensors on four aircraft were left intact (Figure 18) and have been monitored in conjunction with FM sensor data collection (Paragraph 3.3.3). No further Dentronics data was collected following the issuance of the interim report, Reference 10.

Data collection and analysis methods were consistent with those described by Reference 3. Tables A-24 through A-27 list Dentronic sensor data available for the total period and Figure 23 plots this data.

Figure 23 shows the Dentronic sensors have indicated consistent response trends for approximately 1000 hours operation.

An additional measure of fatigue sensor longevity has been developed by the Reference 7 program where FM fatigue sensors have indicated consistent data trends for 1000 hours operation on the T-37 fuselage-empennage.

A-37 sensor installations at the three Air Force bases of Section 3 (England AFB aircraft now reassigned to three bases) have all accumulated approximately 1000 flight hours. In addition, under laboratory conditions (see Reference 4), approximately 50 percent of the sensors tested, performed satisfactorily through a cycle life equivalent to 10,000 flight hours or more. In view of this, it seems likely that the greatest hazard to the longevity of a properly designed sensor installation will be inadvertant mechanical damage.

Reference 10. - "Fatigue Sensor Evaluation Program Interim Full-Scale Fatigue Test and Field Aircraft Instrumentation Report", Cessna Report 318E-7419-039, 31 October 1974.

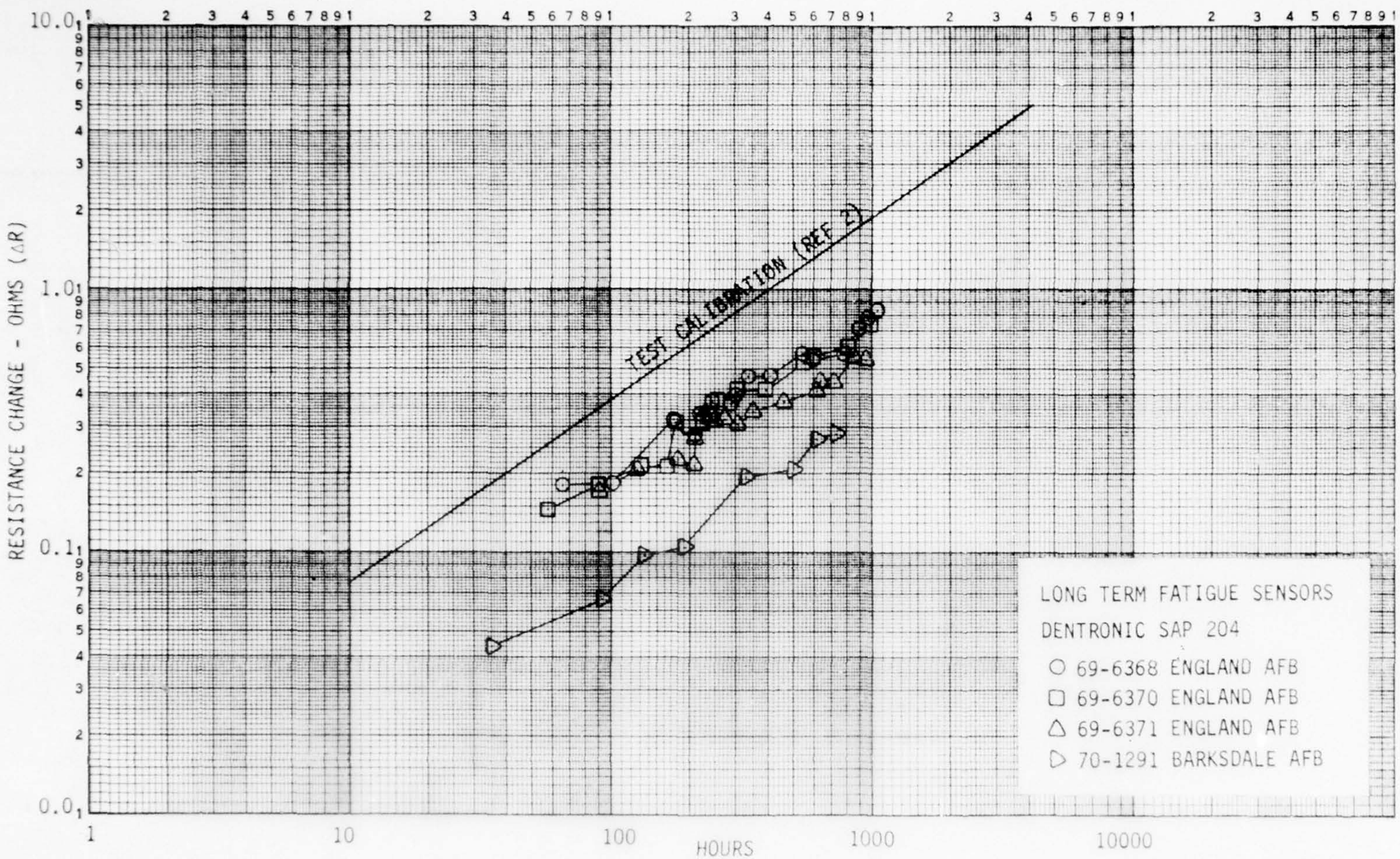

Figure 23 - Dentronics Sensor - Long Term Response

SECTION V

FIELD AIRCRAFT LANDING GEAR INSTALLATION

A INTRODUCTION

FM fatigue sensors were installed on A-37B field aircraft landing gear structure to monitor severity of operational loads relative to the A-37 landing gear fatigue test (Reference 9). Two aircraft (S/N 69-6370, 69-6371) at England AFB were instrumented at four locations identical to the fatigue test. These locations were selected to monitor side and drag loads on each gear.

Location (Reference 8)	Mult	Load Monitored
7MA (LH Main)	2.5	Drag
10ML (LH Main)	3.0	Side
2 (Nose)	5.0	Drag
3NT (Nose)	2.0	Side

B DATA COLLECTION AND ANALYSES

A-37B landing gear fatigue sensors were monitored in conjunction with data collection for FM sensors installed on the wing spar (Section 3.0). Data collection methods were similar to the wing spar except a three prong probe was used to connect the readout indicator (similar to Reference 7 data collection). Tables A-28 and A-29 list landing gear data collected. As with the Dentronics Wing Spar Sensors, no data was collected after issuance of the interim report, Reference 10.

Figures 24 and 25 are comparison plots of test calibration and field aircraft response. Field data are from Tables A-38 and A-29 while test calibration is from Reference 9.

As an indication of operational severity, field aircraft data points are compared in terms of position above or below the test calibration curve. Points above the calibration indicate greater severity while points below indicate less severity. The small sample of field data limits the comparison to only a general indication; trends should be judged accordingly. The following trends are summarized from data comparisons:

a) Field aircraft (training operation) have <u>higher</u> severity of drag loads on both nose and main gear than the fatigue test.

b) Field aircraft (training operation) have lower severity of side loads on both nose and main gear than the fatigue test.

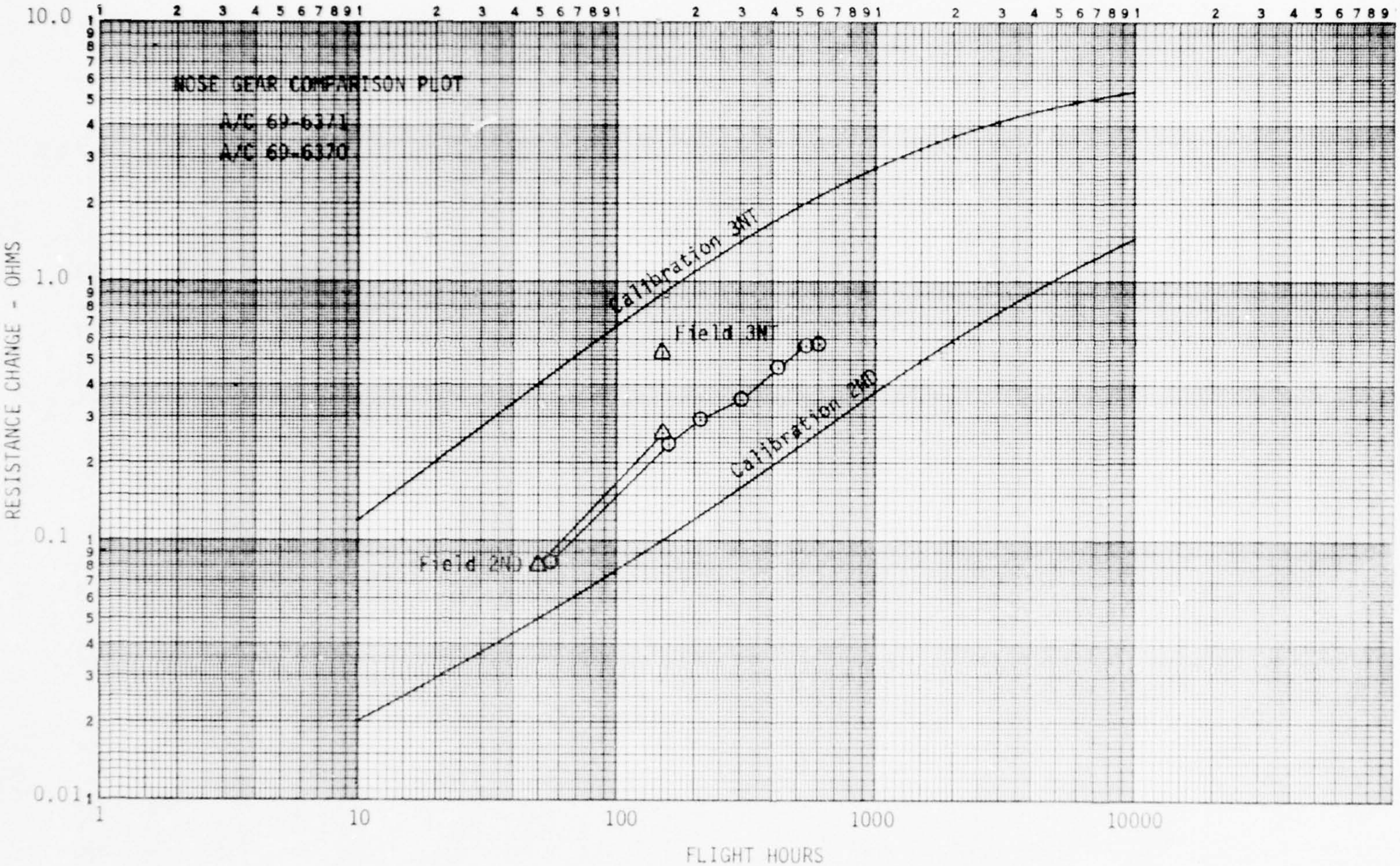

Figure 24 - Nose Gear Comparison Plot

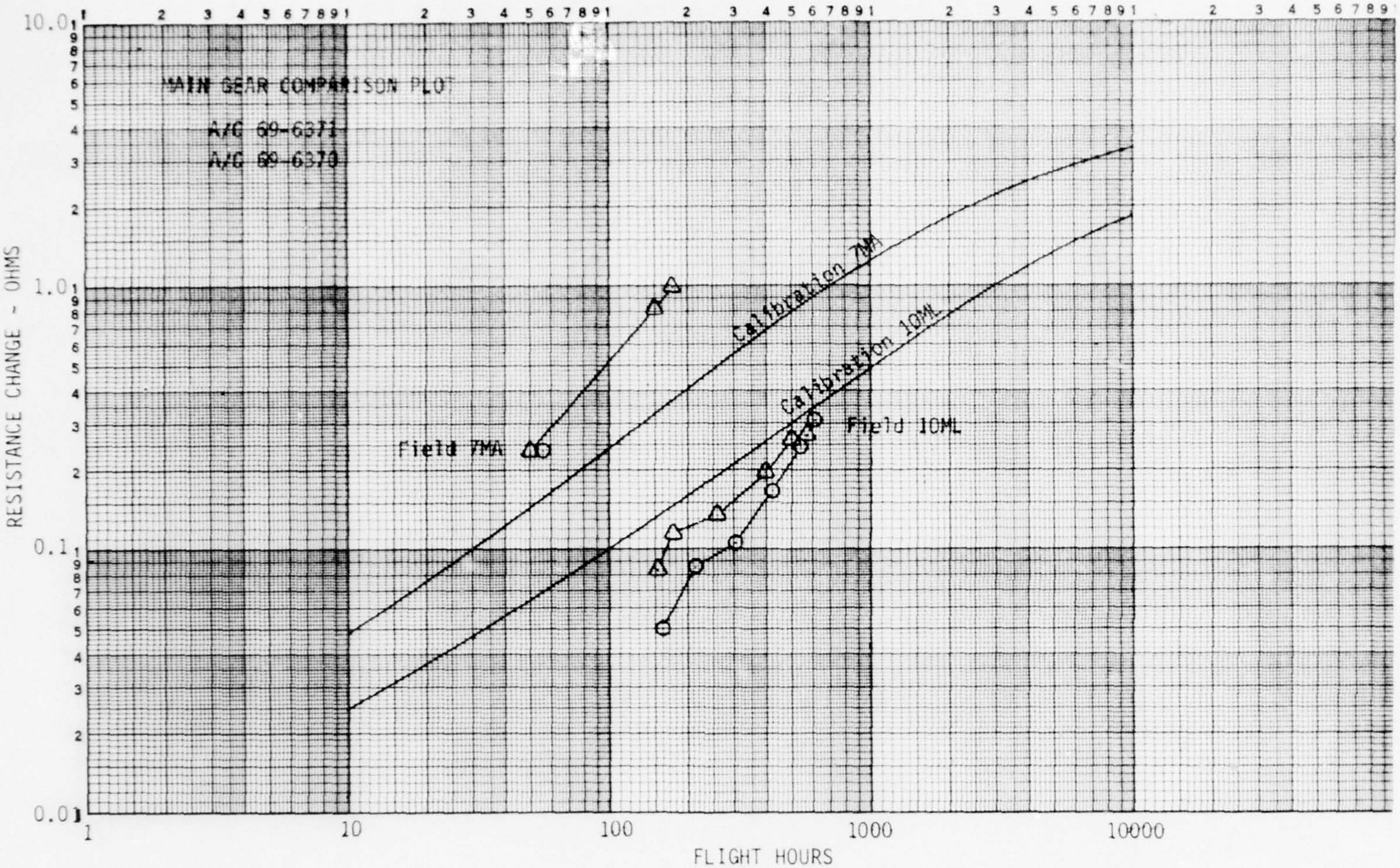

Figure 25 - Main Gear Comparison Plot

SECTION VI

FIELD AIRCRAFT BANJO FITTING INSTALLATION

A INTRODUCTION

Micro-Measurement FM Fatigue Sensors were installed on the forward banjo fitting of six operational field aircraft as a part of the Reference 2 program. The installation was made on new production aircraft 73-1058 through 73-1061 and 73-1063 and 73-1065 in conjunction with the installation of Life History Recorder equipment at the Cessna Wallace Division. The location of these sensors (see Figure 26) was identical to one of the FM sensor locations used in the Fuselage-Empennage Full Scale Test (Reference 7).

B DATA COLLECTION AND ANALYSIS

Data collection was similar to the methods used for the A-37B Wing Spar Installation, except that a Cannon MC12E-8-3PN minature plug and matching socket were used for each sensor. These were made accessible by the removal of a single inspection panel located on the forward side of the banjo fitting (see Figure 27).

The timing of the LHR program was such that these sensors were not installed until the November 1974-April 1975 time period. No readings were taken after August 1975. In addition, this installation was designed as a long term installation using the old comparative severity concept. Therefore, the resistance change data available is not significant.

The banjo fitting fatigue sensor calibration curve based on Fuselage-Empennage Full Scale Test data is shown for reference in Figure 28. Comparison of the available field data with this curve indicates a probability that field usage will be less severe than the test spectrum.

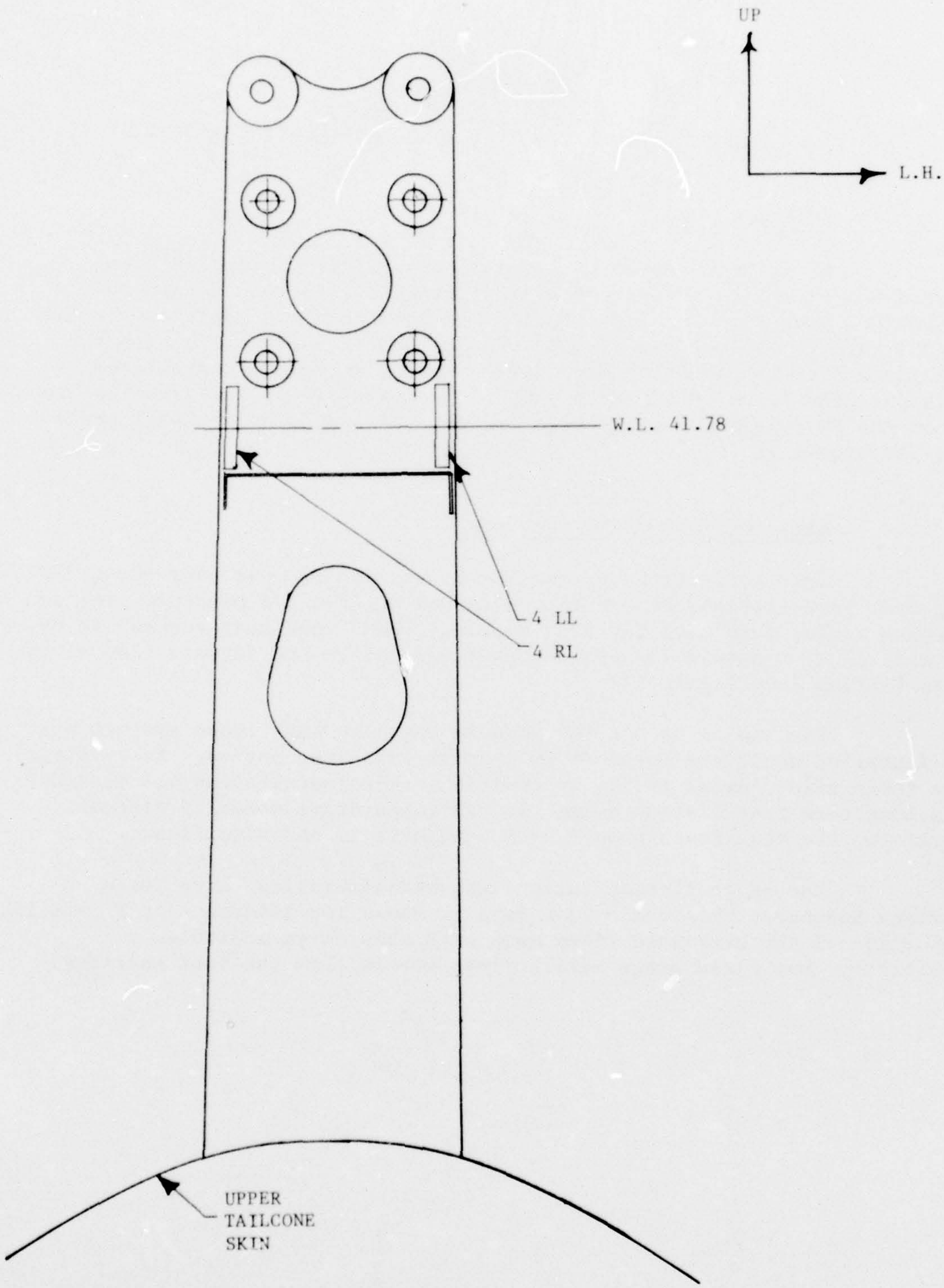

Figure 26
Fatigue Sensor Installation - Forward Banjo Fitting

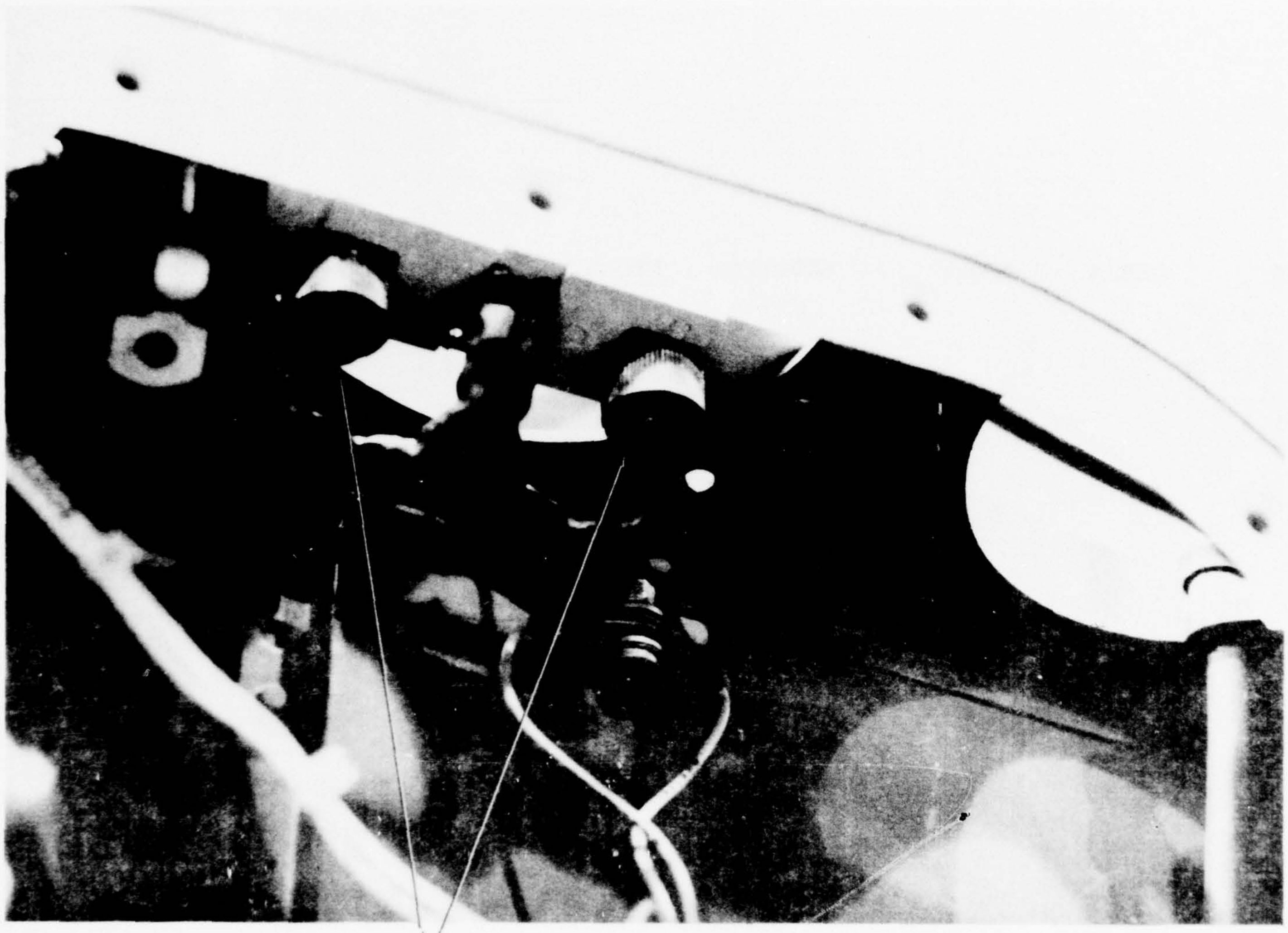

Figure 27 - Access to Plugs, Forward Banjo Fitting

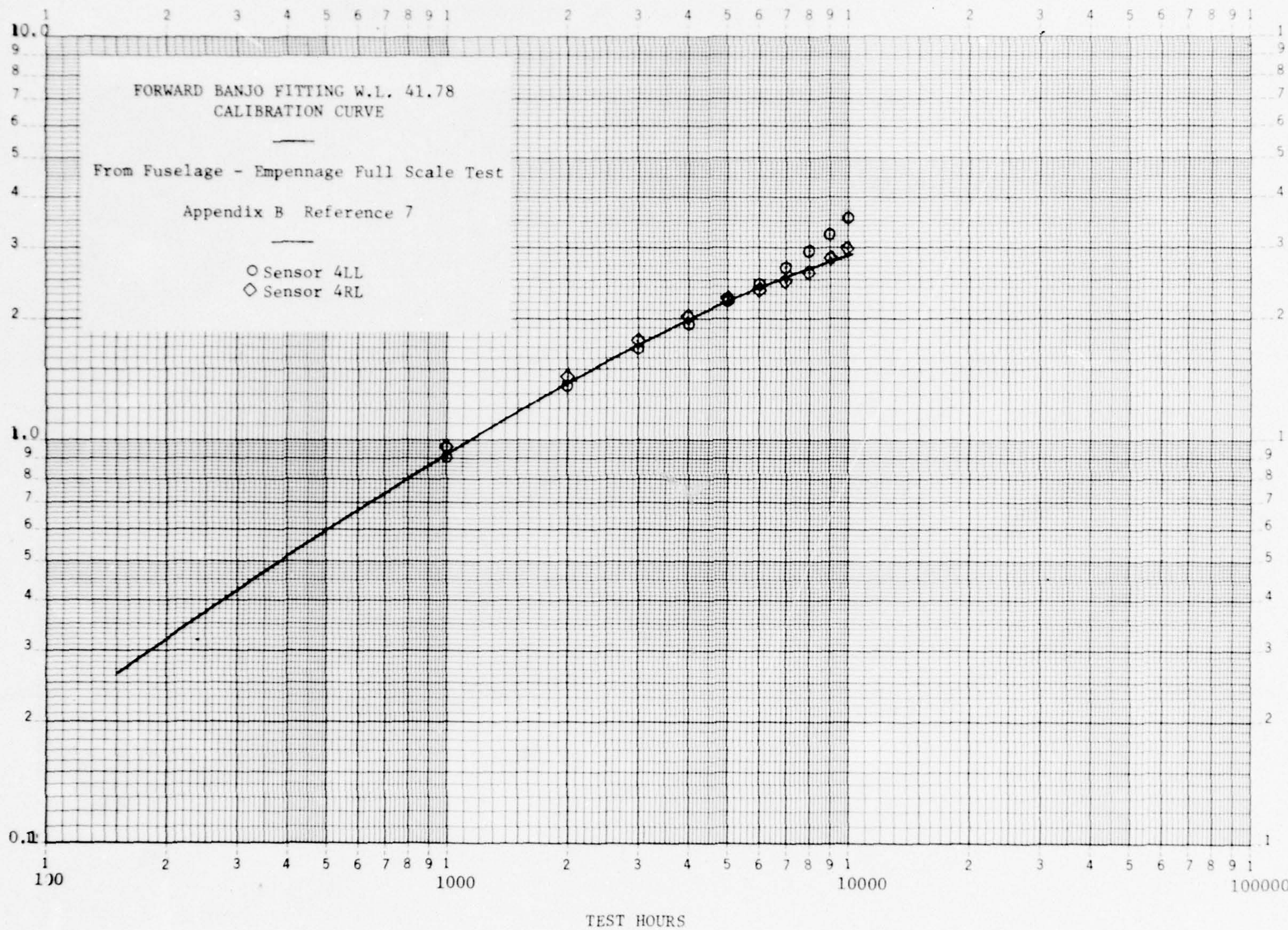

Figure 28 - Calibration Curve - Forward Banjo Fitting

SECTION VII

RESULTS AND CONCLUSIONS

A WORK EFFORT COMPLETED AND RESULTS

1 Wing and Carry-Thru Fatigue Test

a) Installed fatigue sensors at eight locations on final full scale wing and carry-thru fatigue test and developed calibration response.

b) Fatigue sensor response comparison shows:

1. Final test (training spectrum) is more severe than preliminary test (combat spectrum) at the wing root lower surface.

2. Lower wing surface is more severe than upper surface.

3. Lower front spar, W.S. 91.50 is the most severe location (prior to beef-up).

c) Developed calibration response for comparison to field aircraft instrumented at W.S. 55.16 lower front spar.

2 Field Aircraft

a) Installed FM fatigue sensors at the wing root on sixteen A-37B field aircraft at three bases and collected data on a quarterly basis for thirty-six months.

b) Continued monitoring Dentronic sensors installed by Reference 3 program in conjunction with item (a) data collection.

c) Continued monitoring landing gear sensors installed by Reference 9 program in conjunction with item (a) data collection.

d) Installed and monitored banjo fitting sensors per Reference 2.

e) Predicted fatigue sensor response using load spectra measured by mechanical strain gage (scratch gage).

f) Fatigue sensor response comparison shows:

1. Fatigue test is more severe than operational aircraft at the wing root.

2. Severity of operational usage varies with each using command.

3. Fatigue sensors have indicated consistent data trends for 1000 hours field aircraft operation.

4. Operational landing gear drag loads are higher in severity than the fatigue test while side loads are lower in severity based on a limited amount of data.

5. Predicted fatigue sensor response using a measured strain spectrum compares favorably with actual response.

B CONCLUSIONS

Fatigue sensor application to aircraft structural fleet monitoring continues to show promise:

a) Fatigue sensor usage severity trends are consistent and compatible with measured strain history data on both full-scale test and operational aircraft.

b) Long term data collection is possible with minimum effort required; consistent data trends have been indicated for 1000 hours operation on individual aircraft.

c) Field aircraft instrumentation and data collection caused minimum aircraft downtime and produced no burden on users.

C RECOMMENDATIONS

The programs covered by this report were developed using the data comparison method of data analysis, i.e., "this data is more (or less) severe than the reference data." Since the initiation of these programs, more advanced methods of data analysis have been developed (see Reference 1). These methods are capable of:

a) Establishing an approximate strain exceedance curve which produces the same fatigue damage as the actual strain history (Equivalent Exceedance History Method).

b) Indicating directly the fatigue damage accumulated by the instrumented structure (Direct Damage Method).

Based on the availability of these data analysis methods, it is recommended that the field program be redirected as follows:

a) Install fatigue sensors on a sample of USAF Continental United States' aircraft, preferably aircraft with operative Life History Recorder and/or Mechanical Strain Recorder installations. These would be multiple sensor (2 sensors minimum, 3 recommeded) installations for each structural location to be monitored, and would have a maximum spread of sensor multipliers consistent with the expected range of operating strains. This type of installation would be specifically designed for the Equivalent Exceedance History method of data analysis described in Reference 1.

   Apply the data analysis methods and compare results with Life History Recorder and Mechanical Strain Recorder results for field verification and application refinement.

b) Instrument all current production run aircraft with Fatigue Sensors with particular emphasis on aircraft scheduled for foreign military sales.

   1. Install multiple sensors on a sample of each probable fleet grouping. These would be used with the Equivalent Exceedance History data analysis method of Reference 1 to establish typical usage spectrums.

   2. Install a single sensor on all such aircraft. These would be used in conjunction with the Direct Damage data analysis method of Reference 1. This would provide (with the information from paragraph a) a complete fleet tracking program if it should be needed, to aid in the disposition of future structural integrity problems, or to help formulate inspection policies.

To finalize the data analysis methods, the following recommendations are made. These recommendations are also stated in Reference 1.

c) Refine and computerize methods. This would include:

1. Preparing more accurate ΔR versus maximum strain/slope table for Exceedance History Method.

2. Developing a method to establish the effective multiplier of an installed sensor.

3. Computerizing and documenting the use of the Equivalent Exceedance History Method and the Direct Damage Method.

4. Refining the application of mean strain effect.

d) Conduct laboratory tests to obtain:

a. Basic performance data on high multiplier FM sensors. (Higher multiplier will be most adaptable in the proposed method.)

b. Temperature compensation and "creep" data on improved adhesive/sensor combination (M-17 Adhesive).

e) Study the feasibility of methods to relate fatigue sensor response to crack growth. Since a common driving force of cyclic strain exists between fatigue sensor response, fatigue damage, and crack growth, it appears feasible that a method could be developed to relate fatigue sensor response to crack growth.

APPENDIX A

FATIGUE SENSOR DATA

A-37B FATIGUE SENSOR EVALUATION PROGRAM
FULL SCALE TEST AND FIELD AIRCRAFT INSTRUMENTATION
FINAL REPORT

FATIGUE SENSOR DATA TABLE A-1
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 0 Test Hours)

INITIAL ZERO READING	1R	1L	2R	2L	3R	3L
n	5.0	5.0	2.6	2.6	4.0	4.0
ZERO TEMP = 89.8	-0.478	-0.125	-0.090	-0.343	-0.620	0.225

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	1R	1L	2R	2L	3R	3L
1.	4.	90.4	0.023	0.023	0.003	-0.001	0.012	0.015
2.	21.	82.2	0.035	0.027	0.031	0.017	0.069	0.070
3.	26.	80.5	0.046	0.041	0.036	0.029	0.092	0.095
4.	36.	81.2	0.109	0.104	0.131	0.119	0.0	0.291
5.	60.	88.8	0.190	0.189	0.238	0.223	0.0	0.537
6.	107.	82.8	0.268	0.268	0.357	0.343	0.0	0.802
7.	157.	85.3	0.373	0.377	0.507	0.492	0.0	1.142
8.	216.	87.0	0.400	0.406	0.566	0.551	0.0	1.270
9.	250.	82.0	0.460	0.461	0.636	0.620	0.0	1.413
10.	325.	84.8	0.566	0.568	0.775	0.761	0.0	1.702
11.	386.	87.7	0.628	0.631	0.866	0.851	0.0	1.880
12.	459.	84.5	0.671	0.670	0.954	0.939	0.0	2.057
13.	504.	89.0	0.678	0.680	0.962	0.947	0.0	2.075
14.	607.	83.4	0.789	0.787	1.104	1.091	0.0	2.349
15.	703.	86.6	0.836	0.834	1.189	1.181	0.0	2.504
16.	807.	86.5	0.946	0.945	1.319	1.312	0.0	2.740
17.	908.	86.3	1.019	1.011	1.417	1.411	0.0	2.898
18.	1010.	84.7	1.029	1.020	1.443	1.440	0.0	2.943
19.	1113.	85.6	1.110	1.103	1.547	1.544	0.0	3.101
20.	1209.	83.8	1.146	1.137	1.612	1.611	0.0	3.224
21.	1313.	84.5	1.230	1.222	1.702	1.704	0.0	3.422
22.	1416.	86.9	1.283	1.278	1.782	1.785	0.0	3.595
23.	1516.	86.9	1.282	1.276	1.790	1.804	0.0	3.636
24.	1618.	86.9	1.349	1.343	1.867	1.869	0.0	0.0
25.	1714.	87.7	1.382	1.374	1.919	1.920	0.0	0.0
26.	1827.	85.8	1.464	1.451	2.004	2.002	0.0	0.0
27.	1919.	83.4	1.508	1.492	2.064	2.061	0.0	0.0
28.	2023.	88.0	1.515	1.499	2.081	2.082	0.0	0.0
29.	2123.	82.7	1.582	1.562	2.157	2.155	0.0	0.0
30.	2219.	86.0	1.608	1.583	2.207	2.203	0.0	0.0
31.	2270.	83.7	1.657	1.634	2.256	2.252	0.0	0.0
32.	2525.	83.2	1.721	1.691	2.356	2.355	0.0	0.0
33.	2775.	85.6	1.840	1.813	2.515	2.522	0.0	0.0
34.	3031.	84.4	1.898	1.878	2.616	2.615	0.0	0.0
35.	3280.	73.7	2.010	1.957	2.769	2.764	0.0	0.0
36.	3536.	78.2	2.066	2.060	2.888	2.875	0.0	0.0
37.	3786.	81.9	2.166	2.157	3.051	3.010	0.0	0.0
38.	4041.	76.1	2.223	2.210	3.163	3.112	0.0	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
FULL SCALE TEST AND FIELD AIRCRAFT INSTRUMENTATION
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TABLE A-I (Continued)

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	1R	1L	2R	2L	3R	3L
39.	4547.	81.7	2.378	2.340	3.459	3.440	0.0	0.0
40.	5052.	77.1	2.524	2.463	3.775	0.0	0.0	0.0
41.	5557.	76.1	2.710	2.612	4.206	0.0	0.0	0.0
42.	6063.	75.9	2.915	2.762	4.707	0.0	0.0	0.0
43.	6069.	77.5	2.909	2.752	4.709	0.0	0.0	0.0
44.	6072.	78.5	2.912	2.755	4.703	0.0	0.0	0.0
45.	6162.	76.3	2.979	2.786	4.801	0.0	0.0	0.0
46.	6228.	81.5	3.001	2.800	0.0	0.0	0.0	0.0
47.	6265.	82.4	3.001	2.798	0.0	0.0	0.0	0.0
48.	6366.	80.2	3.078	2.841	0.0	0.0	0.0	0.0
49.	6467.	84.2	3.120	2.869	0.0	0.0	0.0	0.0
50.	6568.	82.2	3.129	2.874	0.0	0.0	0.0	0.0
51.	6671.	85.4	3.174	2.913	0.0	0.0	0.0	0.0
52.	6767.	83.8	3.199	2.939	0.0	0.0	0.0	0.0
53.	6871.	85.2	3.265	2.987	0.0	0.0	0.0	0.0
54.	6982.	82.5	3.299	3.015	0.0	0.0	0.0	0.0
55.	7073.	82.6	3.305	3.020	0.0	0.0	0.0	0.0
56.	7176.	83.8	3.355	3.058	0.0	0.0	0.0	0.0
57.	7272.	83.9	3.385	3.074	0.0	0.0	0.0	0.0
58.	7376.	82.3	3.466	3.136	0.0	0.0	0.0	0.0
59.	7477.	81.2	3.524	3.171	0.0	0.0	0.0	0.0
60.	7578.	84.8	3.527	3.176	0.0	0.0	0.0	0.0
61.	7633.	84.0	3.546	3.176	0.0	0.0	0.0	0.0
62.	7682.	82.8	3.580	3.221	0.0	0.0	0.0	0.0
63.	7778.	85.7	3.610	3.240	0.0	0.0	0.0	0.0
64.	7882.	80.4	3.680	3.308	0.0	0.0	0.0	0.0
65.	7983.	83.4	3.714	3.323	0.0	0.0	0.0	0.0
66.	8084.	81.9	3.725	3.326	0.0	0.0	0.0	0.0
67.	8333.	84.3	3.853	3.416	0.0	0.0	0.0	0.0
68.	8589.	81.8	3.931	3.460	0.0	0.0	0.0	0.0
69.	8839.	82.4	4.095	3.551	0.0	0.0	0.0	0.0
70.	9094.	85.4	4.217	3.607	0.0	0.0	0.0	0.0
71.	9238.	81.4	4.332	3.667	0.0	0.0	0.0	0.0
72.	9600.	82.8	4.649	3.764	0.0	0.0	0.0	0.0
73.	10105.	87.9	0.0	3.903	0.0	0.0	0.0	0.0
74.	10610.	86.0	0.0	4.116	0.0	0.0	0.0	0.0
75.	11116.	78.8	0.0	4.344	0.0	0.0	0.0	0.0
76.	11621.	76.4	0.0	4.505	0.0	0.0	0.0	0.0
77.	12126.	77.6	0.0	4.730	0.0	0.0	0.0	0.0
78.	12631.	86.4	0.0	4.974	0.0	0.0	0.0	0.0
79.	13137.	88.2	0.0	5.223	0.0	0.0	0.0	0.0
80.	13642.	86.4	0.0	5.452	0.0	0.0	0.0	0.0
81.	14148.	87.5	0.0	5.739	0.0	0.0	0.0	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

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TABLE A-2

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 0 Test Hours)

INITIAL ZERO READING	4R	4L	5R	5L	6R	6L
n	3.5	3.5	3.5	3.5	3.5	3.5
ZERO TEMP = 89.8	-0.384	-0.067	-0.144	-0.407	-0.292	-0.430

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	4R	4L	5R	5L	6R	6L
1.	4.	90.4	0.040	0.043	0.019	0.024	0.002	0.010
2.	21.	82.2	0.073	0.080	0.070	0.090	0.053	0.011
3.	26.	80.5	0.090	0.098	0.095	0.118	0.066	0.021
4.	36.	81.2	0.246	0.284	0.275	0.333	0.184	0.081
5.	60.	88.8	0.415	0.450	0.454	0.551	0.287	0.140
6.	107.	82.8	0.596	0.631	0.686	0.0	0.414	0.211
7.	157.	85.3	0.824	0.863	0.954	0.0	0.563	0.290
8.	216.	87.0	0.904	0.944	1.082	0.0	0.623	0.320
9.	250.	82.0	1.011	1.066	1.201	0.0	0.696	0.360
10.	325.	84.8	1.218	1.271	1.451	0.0	0.838	0.431
11.	386.	87.7	1.344	1.402	1.613	0.0	0.931	0.483
12.	459.	84.5	1.435	1.494	1.770	0.0	0.997	0.516
13.	504.	89.0	1.464	1.525	1.801	0.0	1.027	0.532
14.	607.	83.4	1.666	1.727	2.051	0.0	1.184	0.620
15.	703.	86.6	1.772	1.833	2.203	0.0	1.265	0.666
16.	807.	86.5	1.964	2.024	2.423	0.0	1.404	0.746
17.	908.	86.3	2.083	2.147	2.594	0.0	1.499	0.801
18.	1010.	84.7	2.111	2.175	2.659	0.0	1.533	0.820
19.	1113.	85.6	2.253	2.307	2.840	0.0	1.649	0.890
20.	1209.	83.8	2.333	2.376	2.960	0.0	1.705	0.922
21.	1313.	84.5	2.490	2.515	3.126	0.0	1.810	0.987
22.	1416.	86.9	2.595	2.609	3.278	0.0	1.889	1.033
23.	1516.	86.9	2.608	2.622	3.327	0.0	1.900	1.040
24.	1618.	86.9	2.812	2.732	0.0	0.0	1.996	1.101
25.	1714.	87.7	2.893	2.800	0.0	0.0	2.045	1.127
26.	1827.	85.8	3.075	2.951	0.0	0.0	2.150	1.187
27.	1919.	83.4	3.172	3.056	0.0	0.0	2.213	1.223
28.	2023.	88.0	3.209	3.098	0.0	0.0	2.245	1.237
29.	2123.	82.7	3.365	3.278	0.0	0.0	2.333	1.286
30.	2219.	86.0	3.449	3.374	0.0	0.0	2.380	1.309
31.	2270.	83.7	3.564	3.477	0.0	0.0	2.443	1.343
32.	2525.	83.2	3.797	3.704	0.0	0.0	2.561	1.401
33.	2775.	85.6	4.248	4.122	0.0	0.0	2.745	1.498
34.	3031.	84.4	0.0	4.412	0.0	0.0	2.861	1.551
35.	3280.	73.7	0.0	4.848	0.0	0.0	3.064	1.636
36.	3536.	78.2	0.0	5.219	0.0	0.0	3.214	1.694
37.	3786.	81.9	0.0	5.815	0.0	0.0	3.431	1.780
38.	4041.	76.1	0.0	6.427	0.0	0.0	3.595	1.831

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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FINAL REPORT
TABLE A-2 (Continued)

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	4R	4L	5R	5L	6R	6L
39.	4547.	81.7	0.0	0.0	0.0	0.0	4.005	1.962
40.	5052.	77.1	0.0	0.0	0.0	0.0	4.516	2.086
41.	5557.	76.1	0.0	0.0	0.0	0.0	5.052	2.204
42.	6063.	78.6	0.0	0.0	0.0	0.0	5.636	2.327

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-3

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 6064 Test Hours)

INITIAL ZERO READING	4R	4L	5R	5L	6R	6L
n	2.6	2.6	3.5	3.5	3.5	3.5
ZERO TEMP = 75.9	0.080	0.122	-0.274	-0.175	-0.340	-0.320

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	4R	4L	5R	5L	6R	6L
1.	6.	77.5	0.038	0.038	0.118	0.118	0.071	0.070
2.	9.	78.5	0.046	0.047	0.130	0.126	0.088	0.090
3.	99.	76.3	0.270	0.299	0.994	0.903	0.541	0.523
4.	165.	81.5	0.360	0.401	1.358	1.220	0.726	0.704
5.	202.	82.4	0.386	0.430	1.468	1.299	0.792	0.766
6.	303.	80.2	0.539	0.599	1.989	0.0	1.087	1.046
7.	404.	84.2	0.646	0.722	2.373	0.0	1.305	1.259
8.	505.	82.2	0.676	0.757	2.509	0.0	1.389	1.341
9.	608.	85.4	0.786	0.878	2.851	0.0	1.604	1.544
10.	704.	83.8	0.844	0.945	3.093	0.0	1.730	1.667
11.	808.	85.2	0.954	1.062	3.479	0.0	1.936	1.857
12.	919.	82.5	1.026	1.144	3.826	0.0	2.095	1.998
13.	1010.	82.6	1.046	1.168	3.938	0.0	2.149	2.053
14.	1113.	83.8	1.124	1.254	4.351	0.0	2.313	2.204
15.	1209.	83.9	1.164	1.302	4.709	0.0	2.414	2.294
16.	1313.	82.3	1.252	1.407	5.444	0.0	2.585	2.450
17.	1414.	81.2	1.304	1.461	5.983	0.0	2.702	2.573
18.	1515.	84.8	1.317	1.476	6.202	0.0	2.751	2.631
19.	1570.	84.0	1.351	1.515	6.650	0.0	2.820	2.699
20.	1619.	82.8	1.386	1.555	7.181	0.0	2.899	2.772
21.	1715.	85.7	1.423	1.596	7.907	0.0	2.992	2.859
22.	1819.	80.4	1.500	1.674	0.0	0.0	3.154	3.017
23.	1920.	83.4	1.536	1.716	0.0	0.0	3.289	3.120
24.	2021.	81.9	1.550	1.735	0.0	0.0	3.387	3.181
25.	2270.	84.3	1.676	1.876	0.0	0.0	3.855	3.510
26.	2526.	81.8	1.745	1.953	0.0	0.0	4.176	3.759
27.	2776.	82.4	1.854	2.093	0.0	0.0	4.682	4.192
28.	3031.	85.4	1.914	2.165	0.0	0.0	5.155	4.573
29.	3175.	81.4	1.970	2.224	0.0	0.0	5.582	4.926
30.	3537.	82.8	2.060	2.330	0.0	0.0	6.514	8.625
31.	4042.	87.9	2.203	2.566	0.0	0.0	0.0	0.0
32.	4547.	86.0	2.335	2.791	0.0	0.0	0.0	0.0
33.	5053.	78.8	2.488	2.926	0.0	0.0	0.0	0.0
34.	5558.	76.4	2.600	3.161	0.0	0.0	0.0	0.0
35.	6063.	77.6	2.719	3.413	0.0	0.0	0.0	0.0
36.	6568.	86.4	2.837	3.583	0.0	0.0	0.0	0.0
37.	7074.	88.2	2.964	0.0	0.0	0.0	0.0	0.0
38.	7579.	86.4	3.098	0.0	0.0	0.0	0.0	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

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TABLE A-3 (Continued)

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	4R	4L	5R	5L	6R	6L
39.	8085.	87.5	3.229	0.0	0.0	0.0	0.0	0.0
40.	8094.	82.6	3.227	0.0	0.0	0.0	0.0	0.0
41.	8119.	86.2	3.236	0.0	0.0	0.0	0.0	0.0
42.	8140.	86.9	3.243	0.0	0.0	0.0	0.0	0.0
43.	8184.	84.7	3.267	0.0	0.0	0.0	0.0	0.0
44.	8251.	89.2	3.304	0.0	0.0	0.0	0.0	0.0
45.	8287.	82.3	3.307	0.0	0.0	0.0	0.0	0.0
46.	8388.	90.5	3.356	0.0	0.0	0.0	0.0	0.0
47.	8491.	80.1	3.384	0.0	0.0	0.0	0.0	0.0
48.	8590.	87.3	3.407	0.0	0.0	0.0	0.0	0.0
49.	8694.	91.9	3.462	0.0	0.0	0.0	0.0	0.0
50.	8789.	88.2	3.531	0.0	0.0	0.0	0.0	0.0
51.	8893.	94.0	3.621	0.0	0.0	0.0	0.0	0.0
52.	8997.	78.8	3.671	0.0	0.0	0.0	0.0	0.0
53.	9096.	82.1	3.698	0.0	0.0	0.0	0.0	0.0
54.	9199.	80.4	3.758	0.0	0.0	0.0	0.0	0.0
55.	9369.	86.3	3.887	0.0	0.0	0.0	0.0	0.0
56.	9399.	87.6	3.918	0.0	0.0	0.0	0.0	0.0
57.	9500.	95.7	3.978	0.0	0.0	0.0	0.0	0.0
58.	9601.	91.6	4.001	0.0	0.0	0.0	0.0	0.0
59.	9704.	82.8	4.037	0.0	0.0	0.0	0.0	0.0
60.	9800.	78.9	4.103	0.0	0.0	0.0	0.0	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-4

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 14148 Test Hours)

INITIAL ZERO READING	4R	4L	5R	5L	6R	6L
n			2.6	2.6	2.6	2.6
ZERO TEMP = 79.2	C.0	0.0	0.205	0.060	0.118	0.243

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	4R	4L	5R	5L	6R	6L
1.	9.	82.6	C.0	0.0	0.017	0.024	0.037	0.028
2.	34.	86.2	0.0	0.0	0.076	0.091	0.108	0.097
3.	55.	86.9	C.0	0.0	0.107	0.124	0.142	0.125
4.	99.	84.7	0.0	0.0	0.186	0.212	0.252	0.221
5.	166.	89.2	0.C	0.0	0.261	0.285	0.346	0.298
6.	202.	82.2	0.C	0.0	C.275	0.302	0.372	0.319
7.	303.	90.5	0.0	0.C	0.381	0.418	0.523	0.448
8.	406.	80.2	0.0	0.0	0.476	0.518	0.638	0.545
9.	505.	87.2	0.C	0.0	0.498	0.541	0.687	0.584
10.	609.	91.9	0.0	0.C	C.595	0.642	0.815	0.692
11.	7C4.	88.2	C.0	0.0	0.642	0.692	0.894	0.759
12.	808.	94.0	C.0	0.0	0.712	0.769	1.006	0.846
13.	912.	78.7	0.C	0.0	C.775	0.835	1.092	0.917
14.	1011.	82.1	0.C	0.C	0.802	0.861	1.123	0.948
15.	1114.	80.4	0.C	0.0	C.860	0.921	1.215	1.025
16.	1284.	86.3	0.0	0.C	C.946	1.005	1.323	1.105
17.	1314.	87.6	0.0	0.0	0.960	1.022	1.364	1.140
18.	1415.	95.7	0.0	0.0	1.013	1.074	1.433	1.194
19.	1516.	91.6	0.0	0.C	1.041	1.103	1.461	1.220
20.	1619.	82.8	0.0	0.C	1.061	1.125	1.505	1.260
21.	1715.	78.9	C.C	0.0	1.115	1.184	1.568	1.317

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 6064 Test Hours)

INITIAL ZERO READING	3R	3L
n	2.6	2.6
ZERO TEMP = 75.9	-0.210	0.288

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	3R	3L
1.	6.	77.5	0.030	0.023
2.	9.	78.5	0.030	0.022
3.	99.	76.3	0.260	0.232
4.	165.	81.5	0.361	0.316
5.	202.	82.4	0.384	0.338
6.	303.	80.2	0.543	0.473
7.	404.	84.2	0.661	0.579
8.	505.	82.2	0.697	0.612
9.	608.	65.4	0.802	0.707
10.	704.	83.8	0.871	0.770
11.	808.	85.2	0.973	0.862
12.	919.	82.5	1.054	0.935
13.	1010.	82.6	1.074	0.952
14.	1113.	83.8	1.148	1.016
15.	1209.	83.9	1.196	1.063
16.	1313.	82.3	1.272	1.131
17.	1414.	81.2	1.326	1.179
18.	1515.	84.8	1.342	1.197
19.	1570.	84.0	1.368	1.229
20.	1619.	82.8	1.398	1.259
21.	1715.	85.7	1.436	1.299
22.	1819.	80.4	1.490	1.358
23.	1920.	83.4	1.524	1.396
24.	2021.	81.9	1.539	1.412
25.	2270.	84.3	1.647	1.538
26.	2526.	81.8	1.717	1.620
27.	2776.	82.4	1.807	1.717
28.	3031.	85.4	1.869	1.786
29.	3175.	81.4	1.915	0.0
30.	3537.	82.8	2.005	0.0
31.	4042.	87.9	2.137	0.0
32.	4547.	86.0	2.266	0.0
33.	5053.	78.8	2.397	0.0
34.	5558.	76.4	2.507	0.0
35.	6063.	77.6	2.611	0.0
36.	6568.	86.4	2.707	0.0
37.	7074.	88.2	2.792	0.0
38.	7579.	86.4	2.886	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

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TABLE A-5 (Continued)

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	3R	3L
39.	8085.	87.5	2.955	0.0
40.	8094.	82.6	2.942	0.0
41.	8119.	86.2	2.944	0.0
42.	8140.	86.9	2.949	0.0
43.	8184.	84.7	2.956	0.0
44.	8251.	89.2	2.975	0.0
45.	8287.	82.3	2.975	0.0
46.	8388.	90.5	2.995	0.0
47.	8491.	80.1	3.023	0.0
48.	8590.	87.3	3.021	0.0
49.	8694.	91.9	3.052	0.0
50.	8789.	88.2	3.061	0.0
51.	8893.	94.0	3.084	0.0
52.	8997.	78.8	3.106	0.0
53.	9096.	82.1	3.117	0.0
54.	9199.	80.4	3.143	0.0
55.	9369.	86.3	3.186	0.0
56.	9399.	87.6	3.188	0.0
57.	9500.	95.7	3.209	0.0
58.	9601.	91.6	3.209	0.0
59.	9704.	82.8	3.206	0.0
60.	9800.	78.9	3.247	0.0

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

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TABLE A-6

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 6064 Test Hours)

INITIAL ZERO READING	7R	7L
n	3.5	3.5
ZERO TEMP = 75.9	-0.263	-0.387

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	7R	7L
1.	6.	77.5	-0.000	0.003
2.	9.	78.5	-0.002	0.002
3.	99.	76.3	0.046	0.061
4.	165.	81.5	0.072	0.087
5.	202.	82.4	0.074	0.091
6.	303.	80.2	0.106	0.130
7.	404.	84.2	0.139	0.168
8.	505.	82.2	0.150	0.180
9.	608.	85.4	0.177	0.212
10.	704.	83.8	0.194	0.233
11.	808.	85.2	0.221	0.264
12.	919.	82.5	0.246	0.292
13.	1010.	82.6	0.251	0.298
14.	1113.	83.8	0.266	0.319
15.	1209.	83.9	0.281	0.335
16.	1313.	82.3	0.303	0.362
17.	1414.	81.2	0.315	0.377
18.	1515.	84.8	0.318	0.382
19.	1570.	84.0	0.328	0.390
20.	1619.	82.8	0.339	0.401
21.	1715.	85.7	0.352	0.417
22.	1819.	80.4	0.377	0.441
23.	1920.	83.4	0.380	0.447
24.	2021.	81.9	0.387	0.455
25.	2270.	84.3	0.427	0.500
26.	2526.	81.8	0.451	0.527
27.	2776.	82.4	0.483	0.560
28.	3031.	85.4	0.508	0.589
29.	3175.	81.4	0.523	0.607
30.	3537.	82.8	0.548	0.651
31.	4042.	87.9	0.595	0.714
32.	4547.	86.0	0.633	0.773
33.	5053.	78.8	0.671	0.823
34.	5558.	76.4	0.696	0.862
35.	6063.	77.6	0.724	0.904
36.	6568.	86.4	0.755	0.962
37.	7074.	88.2	0.779	1.005
38.	7579.	86.4	0.814	1.052

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

TABLE A-6 (Continued)

FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	7R	7L
39.	8085.	87.5	0.844	1.090
40.	8094.	82.6	0.834	1.084
41.	8119.	86.2	0.834	1.083
42.	8140.	86.9	0.838	1.088
43.	8184.	84.7	0.845	1.098
44.	8251.	89.2	0.848	1.101
45.	8287.	82.3	0.845	1.101
46.	8388.	90.5	0.850	1.109
47.	8491.	80.1	0.857	1.121
48.	8590.	87.3	0.856	1.118
49.	8694.	91.9	0.862	1.131
50.	8789.	88.2	0.864	1.139
51.	8893.	94.0	0.868	1.141
52.	8997.	78.8	0.871	1.147
53.	9096.	82.1	0.878	1.158
54.	9199.	80.4	0.880	1.162
55.	9369.	86.3	0.887	1.174
56.	9399.	87.6	0.889	1.177
57.	9500.	95.7	0.894	1.188
58.	9601.	91.6	0.888	1.183
59.	9704.	82.8	0.871	1.170
60.	9800.	78.9	0.899	1.200

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

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FATIGUE SENSOR DATA
A-37 WING-CARRY THRU FULL SCALE TEST (Installed at 23470 Test Hours)

INITIAL ZERO READING	8R	8L
n	2.6	2.6
ZERO TEMP = 67.3	-0.031	0.325

CALCULATED VALUES OF DELTA R

READ	HOURS	TEMP	8R	8L
1.	26.	72.8	0.118	0.128
2.	64.	83.2	0.209	0.221
3.	107.	84.8	0.272	0.282
4.	146.	84.3	0.376	0.385
5.	201.	83.3	0.459	0.469
6.	276.	83.1	0.491	0.500
7.	342.	85.8	0.638	0.608
8.	406.	87.6	0.957	0.726
9.	473.	83.8	0.0	0.774
10.	676.	69.0	0.0	1.029
11.	776.	85.9	0.0	1.060
12.	878.	92.7	0.0	1.175
13.	973.	87.5	0.0	1.243
14.	1076.	58.6	0.0	1.336
15.	1176.	90.0	0.0	1.438
16.	1276.	95.2	0.0	1.446

NOTE-- CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6366	1137.8	1-14-73	82.0

BASE LOCATION IS GRISSOM MULT = 2.5 GAGE FACTOR =9.82

				CALCULATED VALUES OF DELTA R	
READ	DATE	TEMP	HOURS	LH	RH
0.	1-14-73	82.0	0.0	-0.528	-0.170
1.	2-04-73	70.0	45.1	0.028	0.0
2.	2-12-73	61.5	54.7	0.016	0.0
3.	2-23-73	67.0	69.2	0.026	0.0
4.	3-09-73	73.0	84.4	0.028	0.018
5.	4-09-73	60.0	130.2	0.044	0.031
6.	6-22-73	102.2	227.4	0.070	0.0
7.	9-28-73	78.0	393.1	0.115	0.096
8.	1-11-74	49.0	489.2	0.131	0.111
9.	4-09-74	67.0	594.2	0.152	0.132
10.	9-11-74	90.2	716.0	0.196	0.174
11.	1-27-75	28.0	763.2	0.188	0.0
12.	5-12-75	62.0	859.1	0.196	0.174
13.	8-14-75	75.0	925.1	0.188	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

ACFT ORIGINALLY BASED AT ENGLAND AFB, TRANSFERRED AUGUST 1974
LH SENSOR WIRING DISCONNECTED, REPAIRED FOR 3-9-73READING

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6367	1094.9	1-14-73	82.9

BASE LOCATION IS GRISSOM MULT = 2.5 GAGE FACTOR =9.82

				CALCULATED VALUES OF DELTA R	
READ	DATE	TEMP	HOURS	LH	RH
0.	1-14-73	82.9	0.0	-0.395	0.093
1.	2-04-73	69.5	33.5	0.023	0.028
2.	2-12-73	66.0	41.4	0.021	0.017
3.	2-23-73	65.0	51.7	0.029	0.031
4.	3-09-73	74.0	78.5	0.033	0.019
5.	4-09-73	66.0	105.3	0.037	0.027
6.	6-22-73	86.0	205.0	0.036	0.043
7.	9-28-73	82.0	319.6	0.070	0.059
8.	1-11-74	48.0	384.1	0.078	0.066
9.	4-09-74	68.0	464.7	0.105	0.097
10.	9-11-74	74.0	567.3	0.133	0.125
11.	1-27-75	28.0	674.1	0.132	0.134
12.	5-12-75	62.0	683.5	0.129	0.137
13.	8-14-75	75.0	818.5	0.123	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

ACFT ORIGINALLY BASED AT ENGLAND AFB, TRANSFERRED AUGUST 1974

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6368	1061.6	1-13-73	80.1

BASE LOCATION IS YOUNGSTOWN MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-13-73	80.1	0.0	-0.253	-0.498
1.	2-04-73	72.0	29.9	0.022	0.038
2.	2-13-73	55.0	39.4	0.017	0.032
3.	2-23-73	67.0	41.4	0.028	0.041
4.	3-09-73	72.0	65.7	0.019	0.036
5.	4-09-73	63.0	105.4	0.023	0.048
6.	6-22-73	90.0	189.8	0.0	0.064
7.	9-28-73	78.0	300.5	0.0	0.107
8.	1-11-74	64.0	372.4	0.0	0.130
9.	4-09-74	68.0	459.4	0.0	0.145
10.	9-17-74	70.0	597.1	0.0	0.177
11.	1-27-75	76.0	716.4	0.0	0.187
12.	5-13-75	55.0	750.6	0.0	0.181
13.	8-13-75	75.0	835.4	0.0	0.187

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

ACFT ORIGINALLY BASED AT ENGLAND AFB, TRANSFERRED AUGUST 1974
LH SENSOR DAMAGED BY ECP 171 MOD ACTIVITY, REPLACED 9-17-74

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6368	1658.7	9-17-74	82.0

BASE LOCATION IS YOUNGSTOWN   MULT = 2.5   GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	9-17-74	82.0	0.0	0.240	0.0
1.	1-27-75	76.0	119.3	0.031	0.0
2.	5-13-75	55.0	153.8	0.037	0.0
3.	8-13-75	75.0	238.3	0.053	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

TABLE A-12

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6369	1075.6	1-14-73	78.4

BASE LOCATION IS GRISSOM MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	 RH
0.	1-14-73	78.4	0.0	-0.461	-0.494
1.	2-04-73	74.0	24.2	0.028	0.022
2.	2-12-73	56.0	30.8	0.029	0.020
3.	2-23-73	62.0	45.4	0.033	0.016
4.	3-09-73	70.0	62.0	0.039	0.024
5.	4-09-73	62.0	102.1	0.049	0.0
6.	6-22-73	101.8	208.7	0.072	0.050
7.	9-28-73	78.0	346.3	0.107	0.084
8.	1-11-74	49.0	449.4	0.129	0.098
9.	4-09-74	67.0	523.3	0.142	0.119
10.	9-16-74	83.2	647.6	0.162	0.136
11.	5-12-75	62.0	728.2	0.156	0.131
12.	3-14-75	75.0	844.2	0.160	0.134

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

ACFT ORIGINALLY BASED AT ENGLAND AFB, TRANSFERRED AUGUST 1974

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6370	1047.2	1-14-73	77.5

BASE LOCATION IS HANCOCK MULT = 0.0 GAGE FACTOR =0.0

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R: LH	RH
0.	1-14-73	77.5	0.0	-0.320	0.164
1.	2-04-73	74.5	20.6	0.005	0.014
2.	2-12-73	55.5	23.5	0.004	0.001
3.	2-23-73	70.0	34.6	0.012	0.014
4.	3-09-73	69.0	50.5	0.010	0.010
5.	4-09-73	65.0	80.5	0.011	0.019
6.	6-22-73	93.4	84.8	0.018	0.0
7.	9-28-73	77.9	223.6	0.061	0.0
8.	1-11-74	49.0	323.8	0.075	0.0
9.	4-09-74	80.0	396.7	0.103	0.0
10.	8-26-74	85.6	460.2	0.119	0.0
11.	5-14-75	62.0	460.2	0.136	0.0
12.	8-20-75	68.0	668.7	0.128	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

ACFT ORIGINALLY BASED AT ENGLAND AFB, TRANSFERRED AUGUST 1974

RH Sensor Wiring Disconnected

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6371	1077.7	1-14-73	81.0

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-14-73	81.0	0.0	-0.069	-0.105
1.	2-04-73	73.5	33.5	0.013	0.018
2.	2-12-73	67.0	39.6	0.007	0.006
3.	2-23-73	64.0	45.8	0.009	0.017
4.	3-09-73	72.0	62.9	0.019	0.009
5.	4-09-73	67.0	90.6	0.016	0.010
6.	6-22-73	86.0	90.5	0.025	0.014
7.	9-28-73	78.0	209.6	0.059	0.034
8.	1-11-74	65.0	328.3	0.097	0.115
9.	4-09-74	68.0	399.6	0.098	0.0
10.	8-27-74	78.9	537.1	0.148	0.0
11.	9-19-74	74.0	544.9	0.143	0.0
12.	1-28-75	60.0	586.1	0.153	0.0
13.	5-14-75	82.0	640.5	0.161	0.0
14.	8-19-75	81.0	685.9	0.167	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE
ACFT ORIGINALLY BASED AT ENGLAND AFB. TRANSFERRED AUGUST 1974
RH SENSOR WIRING DAMAGED - REPLACED 9-19-74

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6371	1622.6	9-19-74	74.0

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	9-19-74	74.0	0.0	0.0	0.003
1.	1-28-75	60.0	41.2	0.0	0.014
2.	5-14-75	82.0	95.6	0.0	0.035
3.	8-19-75	81.0	141.0	0.0	0.059

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6386	800.0	1-28-73	75.3

BASE LOCATION IS MARYLAND   MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-28-73	75.3	0.0	-0.346	-0.609
1.	3-30-73	55.6	26.8	0.004	0.007
2.	6-28-73	81.0	81.6	0.023	0.003
3.	9-07-73	91.0	181.6	0.023	0.0
4.	1-22-74	43.0	251.6	0.018	0.0
5.	9-19-74	70.0	462.3	0.0	0.072
6.	8-19-75	81.0	563.3	0.0	0.103

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

RH SENSOR WIRING DAMAGED BY ECP 171 MOD ACTIVITY
RH SENSOR RECONNECTED 9-19-74

LH SENSOR RESPONCE LOW, REPLACED 9-19-74

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TABLE A-17

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6386	1262.3	9-19-74	70.0

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

				CALCULATED VALUES OF DELTA R	
READ	DATE	TEMP	HOURS	LH	RH
0.	9-19-74	70.0	0.0	-0.054	0.0
1.	8-19-75	81.0	101.0	-0.031	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6388	600.5	1-28-73	68.9

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-28-73	68.9	0.0	-0.574	-0.824
1.	3-30-73	47.5	71.2	0.033	-0.857
2.	6-28-73	81.2	168.1	0.026	0.0
3.	9-07-73	80.0	267.7	0.030	0.0
4.	1-22-74	53.0	355.6	0.070	0.0
5.	5-07-74	75.0	487.1	0.111	0.0
6.	9-18-74	72.0	556.3	0.123	0.0
7.	1-28-75	40.0	685.5	0.156	0.0
8.	5-14-75	82.0	806.1	0.180	0.0
9.	8-19-75	81.0	912.2	0.208	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

RH SENSOR DEFECTIVE, REPLACED 5-17-74

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TABLE A-19

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6388	1087.6	5-17-74	75.0

BASE LOCATION IS MARYLAND   MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	5-07-74	75.0	0.0	0.0	-0.319
1.	9-18-74	72.0	69.2	0.0	0.021
2.	1-28-75	40.0	199.0	0.0	0.057
3.	5-14-75	82.0	319.0	0.0	0.081
4.	8-19-75	81.0	425.1	0.0	0.116

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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TABLE A-20

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6389	796.7	1-28-73	83.6

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-28-73	83.6	0.0	-0.564	-0.728
1.	3-30-73	47.0	42.8	0.015	0.031
2.	6-28-73	77.5	144.2	0.022	0.036
3.	9-07-73	83.0	204.6	0.0	0.053
4.	1-22-74	43.0	289.7	0.0	0.073
5.	4-29-74	74.0	380.5	0.019	0.087
6.	9-20-74	79.0	557.1	0.0	0.099
7.	1-28-75	40.0	667.2	0.0	0.120
8.	5-14-75	82.0	741.6	0.0	0.126
9.	8-19-75	81.0	829.3	0.0	0.147

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

LH SENSOR WIRING DAMAGED BY ECP 171 MOD ACTIVITY,
RECONNECTED 4-29-74 BUT FOUND TO BE UNSTABLE,
LH SENSORREPLACED 9-20-74

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6389	1353.8	9-20-74	79.0

BASE LOCATION IS MARYLAND   MULT = 2.5   GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	9-20-74	79.0	0.0	0.280	0.0
1.	1-28-75	40.0	110.1	0.042	0.0
2.	5-14-75	82.0	184.5	0.063	0.0
3.	8-19-75	81.0	272.2	0.101	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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TABLE A-22

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6393	638.1	1-28-73	77.2

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-28-73	77.2	0.0	-0.463	-0.533
1.	3-30-73	54.2	58.2	0.024	0.043
2.	6-28-73	76.4	161.7	0.055	0.053
3.	9-07-73	83.0	260.2	0.0	0.090
4.	1-22-74	62.0	360.5	0.0	0.119
5.	9-20-74	78.0	667.1	0.159	0.159
7.	1-28-75	40.0	764.4	0.176	0.178
8.	5-14-75	82.0	876.1	0.327	0.190
9.	8-19-75	81.0	962.7	0.202	0.190

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

LH SENSOR WIRING DAMAGED BY ECP 171 MOD ACTIVITY,
RECONNECTED 9-20-74

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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TABLE A-23

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6397	600.5	1-28-73	69.2

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-28-73	69.2	0.0	-0.402	0.030
1.	3-30-73	47.6	81.5	0.047	0.020
2.	6-28-73	84.2	163.6	0.047	0.014
3.	9-07-73	83.0	201.3	0.0	0.076
4.	1-22-74	43.0	332.0	0.0	0.097
5.	9-20-74	74.0	564.3	0.0	0.169
6.	1-28-75	40.0	691.3	0.0	0.194
7.	5-14-75	82.0	795.8	0.0	0.206
8.	8-19-75	81.0	879.6	0.0	0.234

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

LH SENSOR DAMAGED BY ECP 171 MOD ACTIVITY, REPLACED 9-20-74

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
69-6397	1164.8	9-20-74	74.0

BASE LOCATION IS MARYLAND MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	9-20-74	74.0	0.0	0.372	0.0
1.	1-28-75	40.0	127.0	0.039	0.0
2.	5-14-75	82.0	231.5	0.076	0.0
3.	8-19-75	81.0	315.3	0.098	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

AD-A042 114 CESSNA AIRCRAFT CO WICHITA KANS WALLACE DIV F/G 1/3
A-37B FATIGUE SENSOR EVALUATION PROGRAM - FULL SCALE TEST AND F--ETC(U)
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A-37B FATIGUE SENSOR EVALUATION PROGRAM
FULL SCALE TEST AND FIELD AIRCRAFT INSTRUMENTATION
FINAL REPORT
TABLE A-25

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
70-1288	456.8	1-12-73	47.9

BASE LOCATION IS BARKSDALE MULT = 2.5 GAGE FACTOR =9.82

				CALCULATED VALUES OF DELTA R	
READ	DATE	TEMP	HOURS	LH	RH
0.	1-12-73	47.9	0.0	0.084	0.300
1.	2-03-73	68.0	28.7	0.003	0.001
2.	2-25-73	65.0	70.4	0.012	0.009
3.	3-10-73	74.0	81.8	0.008	0.012
4.	4-07-73	70.0	133.2	0.025	0.020
5.	4-28-73	86.0	145.3	0.027	0.023
6.	6-21-73	95.4	229.2	0.028	0.027
7.	9-27-73	95.1	326.5	0.042	0.046
8.	1-10-74	45.0	411.2	0.049	0.050
9.	4-10-74	67.0	533.2	0.051	0.057
10.	8-27-74	87.4	687.1	0.060	0.066
11.	1-17-75	53.0	868.3	0.071	0.085
12.	5-06-75	88.0	976.9	0.074	0.181
13.	8-18-75	100.0	1102.9	0.081	0.087

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
70-1289	506.8	1-12-73	62.5

BASE LOCATION IS BARKSDALE MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-12-73	62.5	0.0	-0.494	-0.002
1.	2-03-73	66.0	33.8	-0.002	-0.002
2.	2-25-73	68.0	74.3	0.003	0.007
3.	3-10-73	71.0	98.8	0.016	0.002
4.	4-07-73	67.0	123.2	0.007	0.007
5.	4-28-73	85.0	157.2	0.011	0.011
6.	6-21-73	91.1	228.4	0.034	0.022
7.	9-27-73	94.1	347.4	0.041	0.033
8.	1-10-74	45.0	436.2	0.040	0.037
9.	4-10-74	67.0	542.7	0.043	0.042
10.	8-27-74	100.2	716.4	0.055	0.058
11.	1-17-75	53.0	911.6	0.062	0.064
12.	05-06-75	90.0	1048.0	0.067	0.0
13.	8-18-75	100.0	1134.4	0.068	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
70-1290	435.1	1-12-73	53.1

BASE LOCATION IS BARKSDALE MULT = 2.5 GAGE FACTOR =9.32

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-12-73	53.1	0.0	-0.469	-0.365
1.	2-03-73	70.0	30.9	-0.005	-0.009
2.	2-17-73	41.0	53.2	-0.001	-0.010
3.	3-10-73	75.0	77.3	-0.001	-0.006
4.	4-07-73	62.0	101.9	0.003	0.007
5.	4-28-73	84.0	123.4	0.004	0.002
6.	6-21-73	89.2	205.4	0.024	0.018
7.	9-27-73	92.4	336.3	0.041	0.033
8.	1-10-74	45.0	399.9	0.049	0.049
9.	4-10-74	67.0	484.9	0.050	0.046
10.	8-27-74	87.8	670.1	0.066	0.050
11.	1-17-75	56.0	827.8	0.082	0.062
12.	5-06-75	78.0	963.5	0.085	0.063
13.	8-18-75	100.0	1086.5	0.087	0.067

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
70-1291	398.2	1-12-73	57.1

BASE LOCATION IS BARKSDALE   MULT = 2.5   GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-12-73	57.1	0.0	-0.835	-0.358
1.	1-12-73	46.0	1.0	0.029	0.003
2.	2-03-73	63.0	7.5	0.004	0.035
3.	2-17-73	43.0	25.5	-0.043	0.029
4.	3-10-73	74.0	48.7	0.0	0.037
5.	4-07-73	69.0	78.8	0.0	0.041
6.	4-28-73	91.0	104.4	0.0	0.014
7.	6-21-73	83.2	171.9	0.0	0.016
8.	9-27-73	81.0	283.1	0.0	0.022
9.	1-10-74	45.0	325.8	0.0	0.031

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

A-37B FATIGUE SENSOR EVALUATION PROGRAM
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OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 WING STATION 55.16 FWD LOWER SPAR

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
71-0860	40.9	1-12-73	68.9

BASE LOCATION IS BARKSDALE   MULT = 2.5   GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-12-73	68.9	0.0	-0.382	-0.124
1.	2-03-73	71.0	24.2	0.011	-0.005
2.	2-17-73	50.0	38.9	0.002	-0.015
3.	3-10-73	79.0	66.6	0.002	-0.012
4.	4-07-73	73.0	100.1	0.015	0.005
5.	4-30-73	82.0	118.1	0.015	-0.009
6.	6-21-73	89.8	216.8	0.022	0.010
7.	9-27-73	104.0	305.1	0.042	0.028
8.	1-10-74	45.0	392.1	0.048	0.030
9.	8-27-74	123.0	691.7	0.0	0.054
10.	1-17-75	51.0	862.4	0.0	0.063
11.	5-06-75	78.0	1008.7	0.0	0.066
12.	8-18-75	100.0	1126.5	0.0	0.068

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

LH SENSOR WIRING DISCONNECTED-PERMANENTLY DAMAGED

FIELD AIRCRAFT DATA SUMMARY

TABLE A-30
DENTRONICS SENSOR DATA

A/C TAIL NO. - 69-6368

BASE LOCATION - ENGLAND AFB

SENSOR INSTALLATION DATE - 7-25-71

AIRFRAME HOURS - 466.8

GAGE FACTOR - 8.433

ZERO REF. TEMP. - 83°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1 ⚠3	FSL-2 ⚠3	FSR-1	FSR-2
Zero	7-25-71	83	STD #1	0.0	+0.270	+0.030	+0.077	+0.105
1	9-8-71	80	↓	66.2	-0.033	0.032	0.117	0.179
2	10-8-71	85	↓	102.0	-0.043	0.038	0.127	0.182
3	11-20-71	60	↓	175.3	0.012	0.086	0.270	0.321
4	12-14-71	76	↓	209.7	0.042	0.105	0.219	0.281
5	1-6-72	56	↓	221.4	0.079	0.154	0.289	0.339
6	1-22-72	67	STD #1	243.4	0.114	0.160	0.317	0.377
7	2-18-72	56	Partial Fuel ⚠1	285.0	0.002	0.078	0.427	0.497
8	3-6-72	68	STD #1	290.0	0.070	0.130	0.314	0.371
9	3-24-72	75	Empty Fuel ⚠2	302.0	-0.138	-0.056	0.332	0.396
10	5-3-72	66	STD #1	336.8	0.049	0.136	0.382	0.470

NOTES: ⚠1 Partial fuel, this reading is not plotted due to low temperature and loading variation

⚠2 Empty fuel, use a -0.200 correction from loading data

⚠3 These sensors were bonded with EC 2216 which was not mixed properly; poor cure and low bond strength. Data is not plotted.

FIELD AIRCRAFT DATA SUMMARY (Cont'd.)

A/C TAIL NO. - 69-6368

TABLE A-30 (Continued)

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2
11	7-22-72	82	STD #1	413.3	0.096	0.197	0.391	0.469
12	12-5-72	65	STD #1	548.9	0.129	0.214	0.522	0.568
13	1-13-73	61	STD #1	594.8	0.108	0.190	0.492	0.540
14	1-13-73	75	STD #1	594.8	---	---	---	0.492
15	6-22-73	90	STD #1	784.6	---	---	---	0.567
16	9-28-73	78	Add. Stores (1)	895.3	---	---	---	0.707
17	1-11-74	64	No Fuel (2)	967.2	---	---	---	0.783
18	4-9-74	68	Add. Stores (1)	1054.2	---	---	---	0.829

NOTES: (1) BDU-33 practice bombs and LAU-68 W/3RX (+0.018 correction)

(2) Empty fuel, use a -0.200 correction from loading data

FIELD AIRCRAFT DATA SUMMARY

TABLE A-31
DENTRONICS SENSOR DATA

A/C TAIL NO. - 69-6370 | AIRFRAME HOURS - 407.7

BASE LOCATION - ENGLAND AFB | GAGE FACTOR - 8.433

SENSOR INSTALLATION DATE - 7-25-71 | ZERO REF. TEMP. - 84°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1 (3)	FSL-2 (3)	FSR-1	FSR-2
Zero	7-25-71	84	STD #1	0.0	+0.217	+0.227	+0.065	+0.236
1	9-9-71	80	STD #1	90.6	0.239	0.137	0.114	0.170
2	10-8-71	78	Add. Stores (1)	125.9	0.102	0.132	0.167	0.206
3	11-20-71	64	STD #1	180.9	0.167	0.088	0.185	0.224
4	12-14-71	76	STD #1	207.8	0.203	0.087	0.157	0.216
5	12-15-71	68	STD #1	210.2	0.224	0.122	0.229	0.273
6	1-6-72	46	Add. Stores (1)	224.4	0.238	0.181	0.310	0.334
7	1-22-72	68	STD #1	247.1	0.227	0.152	0.251	0.313
8	2-18-72	62	Add. Stores (2)	267.1	0.261	0.221	0.325	0.366
9	3-7-72	64	STD #1	276.5	0.139	0.139	0.307	0.318
10	3-24-72	75	Add. Stores (1)	306.7	0.144	0.099	0.284	0.308

NOTES:

(1) BDU-33 practice bombs and LAU 54 W/3RX (+0.018 correction)

(2) Drop tank L1, R1 and cargo pod L4 (use +0.044 R.H. and +0.065 L.H. load correction) This reading is not plotted due to low temperature and loading variation.

(3) These sensors were bonded with EC 2216 which was not mixed properly; poor cure and low bond strength. Data is not plotted.

FIELD AIRCRAFT DATA SUMMARY (Cont'd.)

A/C TAIL NO. - 69-6370

TABLE A-31 (Continued)

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2
11	5-3-72	64	STD #1	348.2				0.342
12	7-22-72	82	STD #1	463.8				0.377
13	12-5-72	70	STD #1	615.8				0.408
14	1-13-73	61	STD #1	639.5				0.444
15	1-14-73	80	STD #1	639.5				0.376
16	6-22-73	86	Add. Stores (1)	724.3				0.438
17	9-28-73	78	Add. Stores (2)	863.1				0.558
18	1-11-74	58	Partial Fuel (3)	963.3				0.540

NOTES: (1) Drop tank L1, R1 and cargo pod L4 (+0.044 R.H. correction)

(2) BDU-33 practice bombs L1, R1 and empty LAU-68 R3 (+0.018 R.H. correction)

(3) Partial fuel (use a -0.120 correction by assuming full internal fuel)

TABLE A-32
DENTRONICS SENSOR DATA

FIELD AIRCRAFT DATA SUMMARY

A/C TAIL NO. - 69-6371 AIRFRAME HOURS - 472.7

BASE LOCATION - ENGLAND AFB GAGE FACTOR - 8.433

SENSOR INSTALLATION DATE - 7-24-71 ZERO REF. TEMP. - 86°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2 ⚠3
Zero	7-25-71	86	STD #1	0.0	+0.250	+0.267	+0.143	+0.020
1	9-8-71	98	STD #1	57.9	0.117	0.147	0.216	0.046
2	10-8-71	81	STD #1	90.5	0.165	0.180	0.227	0.962
3	11-20-71	69	STD #1	131.1	0.192	0.211	0.228	1.044
4	12-14-71	76	STD #1	163.3	0.171	0.210	0.192	0.996
5	1-7-72	60	Add. Stores ⚠1	177.9	0.283	0.311	0.296	1.092
6	1-22-72	72	STD #1	199.9	0.271	0.301	0.273	1.146
7	2-17-72	74	STD #1	226.8	0.322	0.311	0.297	1.405
8	3-7-72	64	STD #1	240.6	0.339	0.336	0.326	1.488
9	3-24-72	75	Partial Fuel ⚠2	258.2	0.387	0.381	0.398	1.597
10	5-3-72	69	Add. Stores ⚠1	304.6	0.393	0.409	0.377	1.626

NOTES: ⚠1 BDU-33 practice bombs and LAU 54 W/3RX (+0.018 correction)

⚠2 Partial fuel (use a -0.120 correction by assuming full internal fuel)

⚠3 Sensor shows a sharp increase after Reading 1; response after this point continues at a normal rate. Data is not plotted.

FIELD AIRCRAFT DATA SUMMARY (Cont'd.)

A/C TAIL NO. - 69-6371

TABLE A-32 (Continued)

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2
11	7-22-72	82	STD #1	391.5		0.414		
12	12-5-72	65	STD #1	551.0		0.533		
13	1-14-73	70	STD #1	605.0		0.552		
14	1-14-73	83	STD #1	605.0		0.510		
15	6-22-73	86	Partial Fuel (1)	695.6		0.415		
16	9-28-73	78	Add. Stores (2)	814.6		0.603		
17	1-11-74	64	No Fuel (3)	933.3		0.463		
18	4-9-74	70	Add. Stores (2)	1004.6		0.731		

NOTES: (1) No fuel in drop tanks L2, R2 and no B-37K racks L1, R1 (use -0.085 correction estimated from loading data).

(2) BDU-33 practice bombs and LAU-68 W/3RX (+0.018 correction)

(3) Empty fuel, use a -0.200 correction from loading data

FIELD AIRCRAFT DATA SUMMARY

TABLE A-33
DENTRONICS SENSOR DATA

A/C TAIL NO. - 70-1291

BASE LOCATION - GRISSOM AFB/BARKSDALE AFB

SENSOR INSTALLATION DATE - 8-19-71

AIRFRAME HOURS - 69.3

GAGE FACTOR - 8.433

ZERO REF. TEMP. - 85°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2
Zero	8-19-71	85	STD #2	0.0	-0.112	+0.100	+0.097	+0.094
1	10-5-71	78	STD #2	35.4	0.135	0.228	0.011	0.044
2 ⚠1	11-15-71	78		54.6				
3 ⚠4	12-13-71	55/80	STD #2	92.9	0.166	1.338	0.031	0.066
4	1-18-72	39	Add. Stores ⚠2	94.9	0.250	1.987	0.104	0.142
5 ⚠3	3-23-72							
6	5-3-72	80	STD #2	134.8	1.707	3.402	0.300	0.098
7	6-10-72	79	Maintenance ⚠5	155.4				0.052
8	7-21-72	82	STD #2	189.5				0.103
9	1-11-73	54	No Fuel ⚠6	328.9				0.194
10	1-12-73	4 2	STD #2	329.9				0.308

NOTES:
⚠1 A/C is X-C, no data collected.
⚠2 B-37K rack on L4, R4 (use +0.017 correction).
⚠3 A/C in process of transfer to Barksdale AFB; A/C had not arrived at time of reading.
⚠4 Reading taken with different ambient temperature L.H., R.H. Data is not plotted.
⚠5 1200# internal fuel only, R.H. engine removed. A -0.250 load correction estimated, data is not plotted.
⚠6 A/C down for maintenance. A -0.260 load correction applied for all fuel removed.

FIELD AIRCRAFT DATA SUMMARY (Cont'd.)

TABLE A-33 (Continued)

A/C TAIL NO. - 70-1291

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					FSL-1	FSL-2	FSR-1	FSR-2
11	6-21-73	84	No Fuel (1)	500.8				0.208
12	9-27-73	81	Add. Stores (2)	612.0				0.269
13	1-10-74	43	Maintenance (3)	611.7				
14	4-9-74	62	STD #2	727.9				0.280

NOTES: (1) See Note 6, page A.35

(2) B-37K rack on L4, R4 (use +0.017 correction)

(3) Load condition indeterminate, no data collected

FIELD AIRCRAFT DATA SUMMARY

TABLE A-34
LANDING GEAR SENSOR DATA

A/C TAIL NO. - 69-6370

AIRFRAME HOURS - 871.5

BASE LOCATION - ENGLAND AFB

GAGE FACTOR - 9.82

SENSOR INSTALLATION DATE - 7-22-73

ZERO REF. TEMP. - 81°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					7MA	10ML	2ND	3NT
Zero	7-22-72	81	STD #1	0.0	+0.254	+0.320	+0.518	+0.815
1	8-25-72	80	STD #1	50.2	0.236	-0.056	0.080	Not Read
2	12-5-72	70	Partial Fuel	152.0	0.819	0.083	0.260	0.534
3	1-14-73	80	STD #1	175.7	0.992	0.114	△1	△1
4	6-22-73	86	STD #2 △2	260.5		0.132		
5	9-28-73	78	Add. Stores △3	399.3		0.194		
6	1-11-74	58	No Fuel	499.5		0.260		
7	4-9-74	74	Maintenance △4	572.4		0.272		

NOTES:
△1 Nose gear replaced, no further data
△2 Two drop tanks L.H., R.H.
△3 BDU-33 practice bombs and LAU-68 (R3)
△4 Tip tanks removed, no fuel

FIELD AIRCRAFT DATA SUMMARY

TABLE A-35
LANDING GEAR SENSOR DATA

A/C TAIL NO. - 69-6371

BASE LOCATION - ENGLAND AFB

SENSOR INSTALLATION DATE - 7-22-72

AIRFRAME HOURS - 864.2

GAGE FACTOR - 9.82

ZERO REF. TEMP. - 82°F

READ NO.	DATE	AMB. TEMP. (°F)	LOADING CONFIGURATION	Δ HOURS	SENSOR RESISTANCE CHANGE (ΔR OHMS)			
					7MA	10ML	2ND	3NT
Zero	7-22-72	82	STD #1 (3)	0.0	-0.077	+0.530	+0.518	Open (1)
1	8-25-72	85	STD #1	56.2	0.237	-0.040	0.082	
2	12-5-72	66	STD #1	159.5	Open (2)	0.050	0.235	
3	1-14-73	85	STD #1	213.5		0.086	0.292	
4	6-22-73	86	Partial Fuel (4)	304.1		0.105	0.349	
5	9-28-73	78	Add. Stores (5)	423.1		0.165	0.464	
6	1-11-74	64	No Fuel	541.8		0.244	0.564	
7	4-9-74	70	Add. Stores (5)	613.1		0.308	0.572	

NOTES:
(1) Sensor damaged during installation
(2) External damage evident
(3) STD #1 = Full fuel, W.S. 115.50 R.H., L.H. - B37K Rack, W.S. 139.50 R.H., L.H., Drop Tank
(4) No fuel in drop tanks
(5) BDU-33 practice bombs and LAU-68 W/3RX (R3)

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TABLE A-36

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1C58	4.5	1-19-74	70.0

BASE LOCATION IS GRISSCM MULT = 3.0 GAGE FACTOR =9.82

				CALCULATED VALUES OF DELTA R	
READ	DATE	TEMP	HOURS	LH	RH
0.	11-19-74	70.0	0.0	0.229	0.140
1.	12-16-74	60.0	2.0	0.087	0.033
2.	1-27-75	28.0	24.8	0.082	0.033
3.	8-13-75	75.0	187.3	0.147	0.075

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-37

OPERATIONAL AIRCRAFT FATIGUE SENSOR CATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1C59	9.5	1-07-75	76.0

BASE LOCATION IS GRISSCM   MULT = 3.0 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-06-75	68.0	0.0	0.054	0.295
1.	1-27-75	28.0	3.1	0.024	0.031
2.	5-12-75	62.0	102.7	0.013	-0.020
3.	8-13-75	75.0	188.8	0.076	0.095

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-38

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1060	9.6	1-06-75	68.0

BASE LOCATION IS GRISSCM MULT = 3.0 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-C4-75	68.C	0.0	0.092	0.0
1.	1-C9-75	76.0	1.9	0.068	0.0
2.	1-27-75	28.0	15.5	0.070	0.0
3.	.5-12-75	62.0	129.7	0.116	0.0
4.	8-13-75	75.0	207.3	0.140	0.0

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-39

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1061	5.0	1-13-75	72.0

BASE LOCATION IS GRISSOM MULT = 3.0 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-13-75	72.0	0.0	0.094	0.042
1.	1-27-75	48.0	3.3	0.040	0.044
2.	5-12-75	62.0	113.5	-0.006	0.016
3.	8-13-75	75.0	194.0	0.077	0.079

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-40

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1063	5.6	1-14-75	80.0

BASE LOCATION IS GRISSCM MULT = 3.0 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	1-14-75	80.0	0.0	0.272	0.132
1.	5-12-75	62.0	123.0	0.065	0.077
2.	8-13-75	75.0	192.9	0.119	0.151

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED
TO THE ZERO TEMPERATURE

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TABLE A-41

OPERATIONAL AIRCRAFT FATIGUE SENSOR DATA
A-37 FWD BANJO FITTING - WL 41.78

A/C TAIL NO.	INITIAL HOURS	INST. DATE	TEMP REF.
73-1065	8.5	2-4-75	73.0

BASE LOCATION IS YOUNGSTOWN MULT = 2.5 GAGE FACTOR =9.82

READ	DATE	TEMP	HOURS	CALCULATED VALUES OF DELTA R LH	RH
0.	04-11-75	73.0	0.0	0.650	-0.213
1.	5-13-75	55.0	48.1	0.049	-0.076
2.	8-13-75	75.0	120.7	0.086	-0.120

NOTE--CALCULATED VALUES OF DELTA R HAVE BEEN CORRECTED TO THE ZERO TEMPERATURE

APPENDIX B

MEASURED STRAIN SPECTRUMS FOR FATIGUE TEST AND FIELD AIRCRAFT

TABLE B-1 - STRESS EXCEEDANCES AT W.S. 55.16

Measured alternating stress exceedances at W.S. 55.16 FSLC for full-scale test and field aircraft (per 1000 flight hours)

Note: This cycle count based on "NLR" range-pair technique using sequential strain history data

Alternating Stress Range	Preliminary [1] Full Scale Test	Final Full [2] Scale Test	EAFB [3] Field A/C	MANG [4] Field A/C	BAFB [5] Field A/C
0 - 500	27279	61193	27333	32387	34004
500 - 1000	26746	59594	22418	27400	26765
1000 - 1500	26014	58699	14894	18966	13410
1500 - 2000	25771	45450	9796	12178	5826
2000 - 2500	11275	37761	6491	7586	3047
2500 - 3000	5894	16121	4341	4867	1775
3000 - 3500	5298	10245	2976	3060	1223
3500 - 4000	3324	5322	2048	1997	918
4000 - 4500	2059	5068	1482	1395	719
4500 - 5000	1748	2102	1143	1046	544
5000 - 5500	1183	1932	862	842	420
5500 - 6000	898	1627	643	691	308
6000 - 6500	861	1437	500	612	242
6500 - 7000	721	859	384	517	144
7000 - 7500	715	653	272	415	98
7500 - 8000	711	598	210	280	66
8000 - 8500	705	544	148	188	29
8500 - 9000	688	495	108	122	23
9000 - 9500	315	483	54	82	12
9500 - 10000	214	285	27	46	6
10000 - 10500	211	182	18	13	6
10500 - 11000	171	20	4	3	0
11000 - 11500	14	6	4	0	0
11500 - 12000	13	2	4	0	0
12000 - 12500	8	0	4	0	0
12500 - 13000	8	0	0	0	0
13000 - 13500	6	0	0	0	0
13500 - 14000	6	0	0	0	0
14000 - 14500	3	0	0	0	0
14500 - 15000	3	0	0	0	0
15000 - 15500	3	0	0	0	0

1 One layer of this spectrum includes 674 flights and 800 simulated flight hours. Cycles counted per layer were multiplied by 1.250 to obtain cycles/1000 hours.

2 One layer of this spectrum includes 500 flights and 505.3 simulated flight hours. Cycles counted per layer were multiplied by 1.979 to obtain cycles/1000 hours.

3 Measured data based on 188 flights (224.2 hours); cycles counted were multiplied by 4.460 to obtain cycles/1000 hours.

4 Measured data based on 224 flights (303.8 hours); cycles counted were multiplied by 3.292 to obtain cycles/1000 hours.

5 Measured data based on 233 flights (347.6 hours); cycles counted were multiplied by 2.877 to obtain cycles/1000 hours.

TABLE B-2

STRAIN SPECTRUM AT W.S. 55.16

Measured alternating strain spectrum at W.S. 55.16 FSLC for full-scale test and field aircraft (per 1000 flight hours)

Alternating Strain (με)	Preliminary Full Scale Test	Final Full Scale Test	EAFB Field A/C	MANG Field A/C	BAFB Field A/C
23.8	533	1599	4915	4987	7239
71.4	732	895	7524	8434	13355
119.0	243	13249	5098	6788	7584
166.7	14496	7689	3305	4592	2779
214.3	5381	21640	2150	2719	1272
261.9	596	5876	1365	1807	552
309.5	1974	4923	928	1063	305
357.1	1265	254	566	602	199
404.8	311	2966	339	349	175
452.4	565	170	281	204	124
500.0	285	305	219	151	112
547.6	37	190	143	79	66
595.2	140	578	116	95	98
642.9	6	206	112	102	46
690.5	4	55	62	135	32
738.1	6	54	62	92	37
785.7	17	49	40	66	6
833.3	373	12	54	40	11
881.0	101	198	27	36	6
928.6	3	103	9	33	0
976.2	40	162	14	10	6
1023.8	157	14	0	3	0
1071.4	1	4	0	0	0
1119.0	5	2	0	0	0
1166.7	0	0	4	0	0
1214.3	2	0	0	0	0
1261.9	0	0	0	0	0
1309.5	3	0	0	0	0
1357.1	0	0	0	0	0
1404.8	0	0	0	0	0
1452.4	3	0	0	0	0

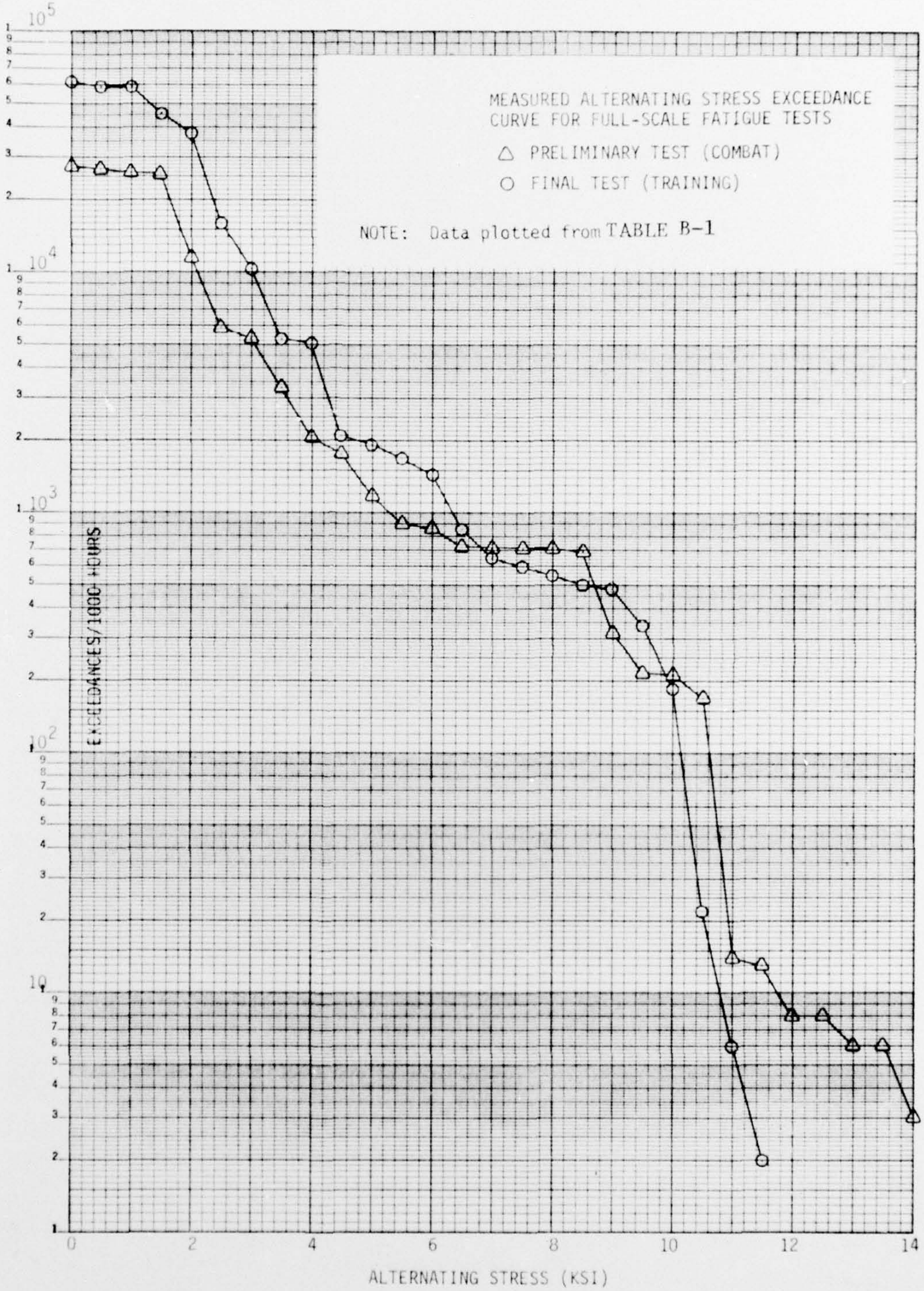

Figure B-1
Stress Exceedances, Full Scale Tests

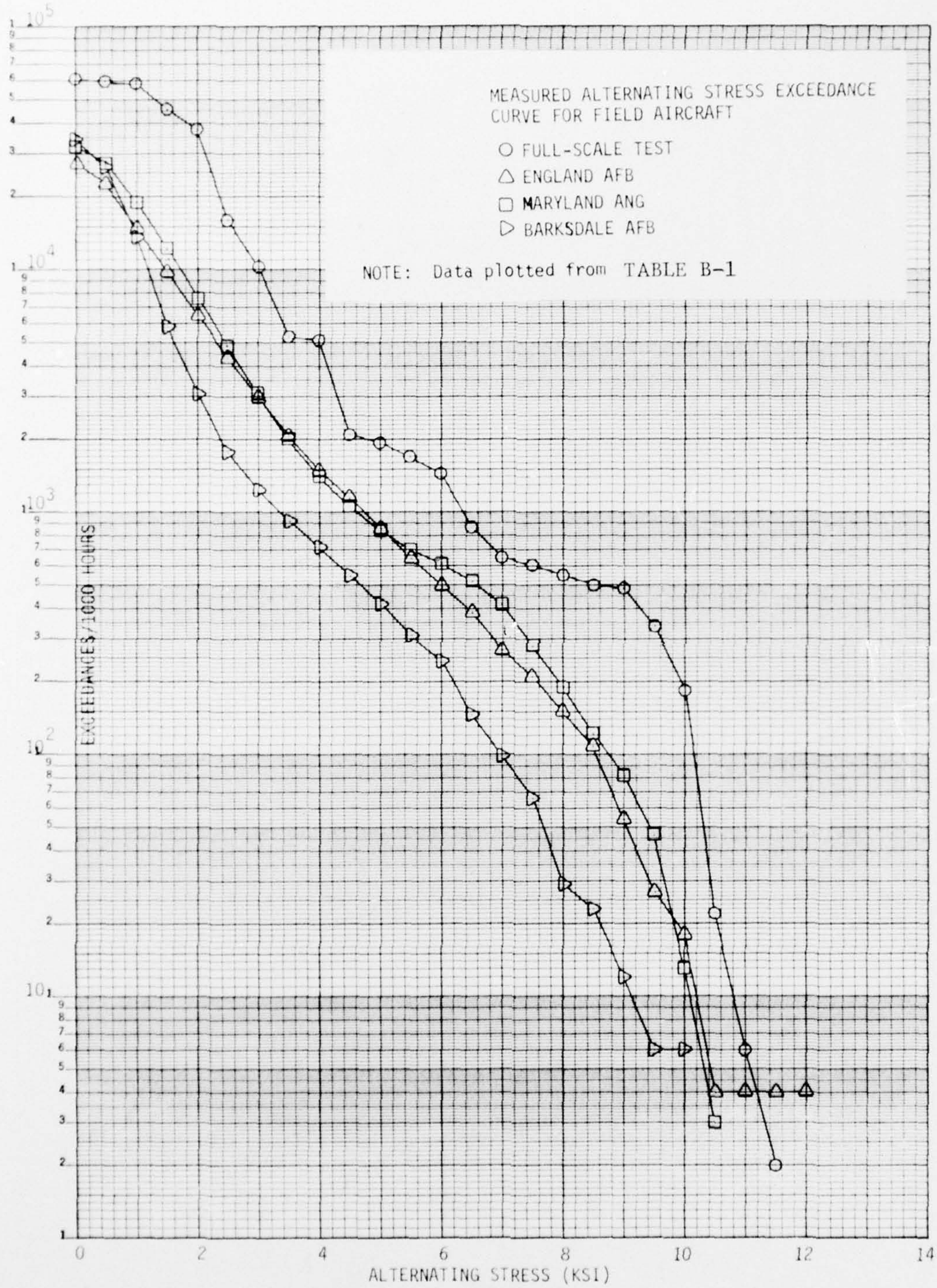

Figure B-2
Stress Exceedances, Field Aircraft

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